SCHOOL SCIENCE AND MATHEMATICS

VOL. XV, No. 2 FEBRUARY, 1915 WHOLE No. 121

THE MISSION OF SCIENCE IN EDUCATION.[1]

BY JOHN M. COULTER,
University of Chicago.

Before determining the method of presenting science in the high school, it is necessary to determine the most valuable contribution of science to education. Perhaps the crux of our differences lies here. If we can agree upon what science should do for us in our work as teachers, we should probably not be very far apart as to the method of securing the result. The variation in method would be no greater than the inevitable and desirable individualism of teachers. If we differ as to the essential contribution of science to education, of course we shall differ as to the methods. The fundamental problem, therefore, is the mission of science in education.

I shall call attention first to some of the results which science is capable of producing, results which are generally acknowledged. It can be used to develop the scientific attitude of mind, which a distinguished theologian recently defined as nothing more than trained common sense.

This attitude of mind is a spirit of inquiry, which recognizes that we are surrounded by a vast body of established beliefs that need a thorough going over to distinguish heirloom rubbish from the priceless results of generations of experience.

It is also a spirit that demands a close connection between a result and its claimed cause. Failure to develop this spirit provides the soil in which political demagoguery, destructive charlatanism, and religious vagaries flourish like noxious weeds.

It is a spirit that keeps one close to the facts, remembering that a fact is influential only in its own immediate vicinity, and that whole systems of thought and belief lie in a region far beyond the sphere of influence of any facts.

In short, it is a spirit that makes for sanity in thought and

[1]Read before the Annual Conference of High School Teachers, University of Illinois, Nov. 20, 1914.

action, a spirit which is slowly increasing in its influence, but which as yet does not control the majority of citizens. Any subject that can be used to cultivate this spirit is of the greatest practical importance.

Of course the methods introduced by science are now being developed in connection with other subjects, and the same result may be obtained through them; but it still remains true that the scientific spirit just described is more easily and effectively developed in contact with the concrete materials of science.

A stronger claim for science can be made, however, as an essential constituent of all education. It gives a training peculiar to itself, and one that is essential in every well balanced education. It is this contribution that I wish to emphasize.

I shall assume that any peculiar result of science in education must be obtained, not through information in reference to the facts of science, but through contact with the materials of science. However valuable information may be, it can hardly be regarded as a substitute for knowledge. Information is always at least second hand, while knowledge is first hand. The real educational significance of personal experience, which is a better name for what we call the laboratory method in education, is very commonly overlooked, even by teachers of science.

We were first told that science teaches the laboratory method, the inference being that the content of science is of no particular educational advantage in itself, but is merely useful in teaching a valuable method. Of course this method holds no more relation to science than do algebraic symbols to algebra; they both represent merely useful machinery for getting at the real results.

Then we were told that science cultivates the power and habit of observation. Of course it does, but this is not peculiar to training in science, for it belongs to any subject in which the laboratory method is used.

Then it was claimed that the study of science trains the powers of analysis. This is certainly getting the subject upon higher ground, for the power of analysis is of immense practical importance, but to imagine that analysis is the ultimate purpose of science in education, is not to go very much further than to say that the ultimate purpose is the laboratory method. The latter is the method, the former is but the first step in its application, and is by no means peculiar to science.

Beyond analysis lies synthesis, and this certainly represents the ultimate purpose of science. The results of our analysis are

as barren as a bank of sand until synthesis lays hold of them; but even synthesis is not peculiar to science. To pass by the incidental and the temporary, and to reach the real and permanent contribution of science to education is to discover that it lies, not in teaching the laboratory method, in developing the power of observation, in cultivating the spirit of analysis, or even in carrying one to the heights of synthesis, but in the *mental attitude demanded in reaching the synthesis*. In this regard the demands of science are diametrically opposed to those of the humanities, for example, using this loose term to express the great region of literature and its allies. The general effect of the humanities in a scheme of education may be summed up in the single word *appreciation*. They seek to relate the student to what has been said or done by mankind, that his critical sense may be developed, and that he may recognize what is best in human thought and action. To recognize what is best involves a standard of comparison. In most cases this standard is derived and conventional; in rare cases it is original and individual; in no case is it founded on the essential nature of things, in absolute truth, for it is apt to shift. It is the artistic and aesthetic which predominates, not the absolute. The whole process is one of *self-injection* in order to reach the power of *appreciation*. Any education which stops with this result is incomplete, for there is another mental attitude which is a necessary complement before a full rounded education can be claimed. This complementary mental attitude is developed by a proper study of science.

If the study of nature is conducted so as to cultivate chiefly a sentimental appreciation of natural objects, it is merely more of the same thing. If it is conducted so as to store the memory chiefly with encyclopedic information, it misses the high level of its educational opportunity. If the proper intellectual result of the humanities is *appreciation*, whose processes demand *self-injection*, the proper and distinctive result of the sciences is a *formula*, to obtain which there must be rigid *self-elimination*. Any injection of self into a scientific synthesis vitiates the result. The standard is not a variable and artificial one, developed from the varying tastes of man, but absolute, founded upon eternal truth.

Two such distinct mental attitudes as self-injection and self-elimination must receive attention in education, which cannot be complete without both. They are not contradictory, but complementary. The exclusive cultivation of either one must result in a lop-sided development. Persistent self-injection tends to

mysticism, a confusion of ideals, or even vagaries, with realities, a prolific cause of all irrational beliefs. Persistent self-elimination narrows the vision to a horizon touched by the senses, and clips the wings that would carry us now and then beyond the treadmill of life into a freer air and a wider outlook. The two processes and the two results are so distinct and so complementary that any scheme of education which does not provide for the definite cultivation of these two mental attitudes is in constant danger of resulting in mental distortion.

This seems to be the great and unique mission of science in the education of men and women, and nothing more superficial or temporary should divert us from it. It is men and women we have in mind, and not science, or the various subjects under which it is organized. It is obvious that this mission must reach the greatest number, and therefore its beginnings cannot be deferred to the educational schemes of colleges and universities, where the small minority are in training. This work, therefore, is a high school problem. We face the question as to the most effective method of accomplishing it.

The problem is peculiarly difficult because it has been much confused by the various standards used to measure the results. In the main these standards have been too concrete, such as the immediate effect of science upon the earning capacity of the student; the amount of useful information a student may carry into his subsequent life; the number of ordinary phenomena the student can pretend to explain, etc. Too often the higher intellectual standard is lost sight of, the standard of a mind trained to an effective attitude towards all subjects, an attitude that persists when unrelated facts are forgotten.

This confusion becomes worse confounded when incompetent teaching enters into the program, and the obvious results of lack of interest, and lack of any practical or intellectual outcome, are referred to science as a subject rather than to the teacher as an incompetent. From the midst of all this confusion, leading to merited criticism and a babel of opinions, there emerge some facts which seem clear.

Science has become so vast and so complex a subject, and in addition to this, is so growing a subject, that no teacher can command even its most elementary everyday phases. There was a time when men taught Natural Science; there is no man who can do this now. If the most obvious facts of science are to be presented truthfully, they must be presented by teachers trained in

the various fields of science. If much confusion has arisen from teachers incompetent in some field of science, the amount of confusion that would result if the same group should attempt to teach *all* science, must be left to the imagination. Of course, in everyday experience we face nature as a synthetic affair, but you must remember that synthesis is the last step in progress, and is an impossible first step. This means that we must begin by laying hold of single threads and following them, until finally we see them woven into the intricate pattern we call nature; and this is the process that brings appreciation, insight, and intellectual equipment; the process that enables science to achieve its peculiar mission in education.

An illustration may be taken from another synthetic experience, common in large cities, as in Chicago, for example. Almost all the living languages are represented in its population, and yet it would hardly seem rational to teach a child foreign languages all at once, by picking out the commonest words and phrases from each. The result might be some scrappy information, but to call it education in language would be far from the mark. The real synthetic study of language is philology, based upon some organized knowledge of the different languages.

A division of the materials of science seems necessary, therefore, not only to secure competent teaching, which is a practical reason, but also to secure a point of view that represents the permanent possession which is the essential feature of education. This does not mean organization for the sake of a subject, but for the sake of a pupil; an organization which means a structure that abides, and not inchoate building material.

I sympathize fully with the demand that the materials selected should be more related to the experience of pupils. This is common sense, and therefore science. I confess that this has been too much lost sight of in our zeal to organize knowledge so that it may be permanent; but the material selected may vary, while the use to which it is put remains the same. The appeal to experience for our material, and the use of this material in organizing a definite body of knowledge, is the combination that will retain all that is vital in our past teaching, and admit all that is helpful in the new demands.

Experience teaches us many things, and changes must be made that will satisfy every possible need, without destroying things that are more important. A tree may be made to yield more and better fruit by pruning and grafting, but not by uprooting. My

picture of the situation in science teaching is that of a tree, rooted and grounded in all the good that the past has revealed, but reaching out its branches and ever renewed foliage to the air and the sunshine, and taking into its life the forces of today.

I have met hundreds of students, entering the university from all parts of the country, who have had work in science in high schools, and although the results have been variable, they have been in the main so satisfactory that it is clear to me that science teaching in the high schools has not been a failure. Those who state that it is a failure must mean that it has not been as successful as it is capable of being made. I have been interested in tracing the comparative failures to their sources, and invariably I have encountered incompetent teaching as the responsible cause, rather than the materials of science that have been presented. The majority of cases, however, that have come under my observation are not failures, for they have brought to me a substantial foundation upon which to build, and what is more important, an aroused interest of their own to build upon the school foundation.

It may be claimed that this evidence is very partial, since it includes only the select few who pass from the high schools into the universities, while the major product of the high schools passes directly into the activities of life. Just how this dissolving crowd can be followed and estimated I am at a loss to imagine. Of course, general impressions are current, which are propagated from no definite source of reliable data. For example, I have heard a business man condemn the whole system of high school education because of an unhappy experience with one high school graduate. Nothing is more common than such illogical generalizations, and they may become propagated so extensively as to be regarded finally as a "public demand." The average "public demand" is about the vaguest scientific proposition one ever encounters.

It has been assumed by some that the large majority of high school students need a type of science instruction entirely different from that which has been given. This assumption is either a response to public demand. or a pedagogical abstraction, and in neither case can it rest upon a convincing body of evidence.

Some of the implied criticisms of the present methods are rather hard to be understood by one who is merely observing the discussion, rather than participating in it. For example, if any science teaching deals with "abstractions" and "generalizations"

rather than with concrete material, it is not science teaching. That there should be a certain amount of generalization, based upon observed facts, is obvious, for this is making facts live, which is the pedagogy of the subject. That our science teaching should consist only in explaining to a student what he encounters in his own experience, is to limit his life, rather than to enrich it by extending his horizon. There are many things worth knowing which we only begin to experience when our attention is called to them.

Perhaps, however, the best expression of the opinion that the current method of teaching science should be changed entirely is to be found in the recent texts on "General Science." I find myself quite in accord with the motive of what is called "general science," in so far as it voices a growing opinion that high school students should know more about science in general, and tries to meet this opinion with a method. What I cannot agree with is the method, and for reasons indicated in a general way in the preceding part of this paper. A mosaic made up of fragments of information breaks up all natural connections, and forbids the development of those ideas which relate and hold facts. As I have said, it seems to be really a substitution of the encyclopedic for the educative. The relations suggested by a mosaic are purely artificial, and never can develop a body of ***knowledge,*** as contrasted with a body of *facts.* With me this is a matter of pedagogy, that is, of the child, and not at all of the sciences as partitioned off into different fields. These sciences can take care of themselves, but we must make them render the best possible service in the education of children.

As one advances through a university, the subjects of science become more and more subdivided, on account of our rapidly growing knowledge. Subdivisions of this kind have no place in elementary instruction, but there are groups of these subjects which are units, so far as education is concerned. It is these natural educational units that must be preserved (and they are not numerous), if science is to do its perfect work in education. I do not understand how an inextricable tangle of these units can be regarded as an education *in* science; certainly it is not an education *by* science.

Of course, when these few natural units are segregated, and perhaps called by names indicating that they are not specialized sciences, then the common experience of life should enter into the choice of illustrative material. We cannot meet the demand

for more general acquaintance with science by putting all the sciences into a short course. Such a general acquaintance can only be obtained by extending the time given to science instruction. My program, therefore, would be: enough time for science, so that its natural units may be developed, and also better teaching all along the line.

MATERIALS FOR A COURSE IN ANIMAL HUSBANDRY.[1]

By W. H. Smith,
University of Illinois.

The purpose of this paper is to discuss the subject matter and use of supplementary materials for a course in Animal Husbandry in the secondary schools.

As a basis for this discussion, I will define Animal Husbandry as that branch of agricultural science which deals with the history, judging, feeding and management of farm animals. The term "farm animals," as used above, refers to the various breeds and classes of domestic animals common to the farms of this country. When we realize that this includes over fifty distinct breeds, each having its own peculiar characteristics, adapting them to special uses and conditions of environment and management, we have a partial insight into the field of Animal Husbandry.

With only one semester devoted to the study of Animal Husbandry, it is plainly seen that it would not be wise or even possible to make a detailed study of all the various kinds of farm animals, even though most textbooks take up the subject matter in that way. Fundamental principles applicable to all classes of live stock may be studied, but the instructor should first study local conditions and find out the kind of animals most common in his section and easiest obtainable for class use, and center the work around them. It would be more advisable to make a detailed study of a few classes of animals common to the community than to touch lightly on many with which the student, perhaps in the course of a lifetime, would never come in contact.

[1]Read at the November, 1914, meeting of the C. A. S. & M. T. held at Hyde Park High School, Chicago.

For example, in a section where interest in beef cattle is keen, it would be well to take up the study of this class of animals and familiarize the student with the subject matter in some simple, yet definite way. The other classes of animals should be taken up afterwards in a similar way, so that at the end of the course, the student should have a fair knowledge of several classes of animals. The following outline will serve for this purpose:

I. THE LIVE STOCK INDUSTRY.
   A. Importance.
      1. Value of live stock in the United States and in the world.
      2. Live stock industry compared to other industries in this country.
      3. Basis of other industries.
   B. Advantages of Live Stock on the Farm.
      1. Maintains soil fertility.
      2. Distributes labor throughout the year.
      3. Utilizes the by-products and feeds of low market value.
      4. Develops interest in other farm work.
   C. Disadvantages.
      1. Amount of capital necessary.
      2. Risks of disease.
      3. Unstable markets.

II. THE BEEF CATTLE INDUSTRY.
   A. Origin and Development in this Country.
   B. Number and Value of Beef Cattle in Illinois, United States, and the World.
   C. Present Outlook; Market Conditions, Etc.

III. HISTORY.
   A. History of Four Beef Breeds:
      1. Shorthorn.
      2. Hereford.
      3. Aberdeen-Angus.
      4. Galloway.

IV. FEEDING AND MANAGEMENT.
   A. Principles of Feeding:
      1. Food nutrients.
      2. Classification of feeds.
      3. Digestibility of feeds.
      4. Rations.
      5. Calculation of rations.
      6. Efficiency of rations.
   B. Feeding Beef Cattle:
      1. Rations for fattening cattle.
      2. Rations for breeding cattle.
      3. Rations for baby beef.
   C. Barns and Equipment.

V. JUDGING.
   A. Judging Beef Cattle:

1. Fat cattle.
2. Breeding cattle.
3. Breed types and characteristics.

B. Market Classes and Grades of Beef Cattle.

1. Market Reports.

The object of Part I in the outline, "The Live Stock Industry," is to teach the student the importance of Animal Husbandry as one of the fundamental industries of this country, and at the same time to give a viewpoint which will establish and maintain his interest in the work that follows.

Under Part II the student should first become familiar with a few facts concerning the history of the most important breeds of the class of live stock studied. This should include a knowledge of the origin, development, and early improvers of the breeds, as well as the names of some of the noted breeders and leading show animals of the present day[2].

Before beginning the work on systems of feeding for any particular class of animals, it would be advisable to spend some time on the Principles of Feeding, to teach the student the fundamentals which are applicable to all animals. This work should include a study of: Food Nutrients and Their Uses in the Body; Composition, Classification, and Digestibility of Feeds; Balancing of Rations; etc. To supplement this work, samples of home-grown feeds may be obtained from the local feed stores or elevators, while the commercial feeding stuffs will be furnished gratis by the larger feed or milling companies and the packing houses. These samples, and others showing the chemical composition of feeds are extremely helpful in presenting this phase of the subject.

With the Principles of Feeding well in hand, the student may be assigned the study of various rations for fattening and breeding cattle, and for baby beef production. In connection with this work, visits to practical feeding plants may be made where rations can be studied to determine their nutritive value according to the principles already learned in the class room. It would also serve as a means of getting the school and practical man together for their mutual benefit. At the same time a study of barns and equipment could be made and later reported on by the student.

Likewise, animals could be obtained for teaching the fundamental principles of judging, which should include the names,

[2]May be obtained from "Breeder's Gazette" fair reports.

location, and relative value of the various parts; the use of the score card, and comparative judging, general types and breeds of the various classes of animals. A large number of animals are not required for scoring work. One animal each day for several days will bring out the value of the score card in teaching the names, location, and relative value of the various parts fully as well as having several. When these points are well in hand, more animals should be obtained for comparative judging and the student thoroughly drilled in giving reasons for his placings.

At the University of Illinois we do not attempt to make finished judges of our first-year men, but endeavor to teach them the fundamentals of judging for a foundation with which they can, with practice, become more or less efficient judges. I believe in some of the advanced high schools this can be accomplished, likewise, at least to the extent of teaching the student to be able to distinguish between a good and an inferior animal and to point out intelligently the differences between animals. There are few branches of study that will be of greater interest and as helpful in developing the powers of observation and sound judgment in a student as that of judging live stock.

To supplement the judging work, the breed photographs and lantern slides can be obtained which will aid very materially in teaching the correct types and characteristics of the various breeds. Slides may be secured from the U. S. Department of Agriculture, and photographs may be obtained from the various breed associations.

When the study of market classes and grades of beef cattle is taken up, the introduction of the live stock papers and market reports should be made. These papers show the commercial application of this system of classifying animals, and interpret the value of them according to the differences that have been pointed out in the judging work. To get the student interested to the point of following the live stock market and interpreting its reports is worthy of the instructor's earnest efforts.

Besides the work with the larger domestic animals, poultry holds an important place in a course of Animal Husbandry. Professor Muckelroy of Southern Illinois State Normal, in speaking of poultry in this connection, says: "I hope that poultry will soon become standard school equipment; first, because practically every home, city or country, has poultry. Pure-bred poultry is growing in popularity. Its products are increasing in demand as pure food and cost of living concern us; it does not occupy much

space; it requires small investment, is self-supporting, and may be made a source of profit if properly managed. The same general principles of breeding and feeding apply equally to horses, cattle, sheep and swine. The rapidity with which poultry multiplies and the shortness of time for development makes it especially well adapted for such courses. This work I place as a very valuable accessory to the study of Animal Husbandry."

In teaching a course of this kind, difficulties will arise, chief of which will be the securing of live stock specimens. This may be partially overcome by the use of supplementary material, but when animals cannot be provided at the school, the instructor should plan trips to places where animals may be secured. This of course means added responsibility and work on the part of the instructor, but the interest secured in the course makes it well worth while.

It is almost imperative that the instructor make the trip first to become acquainted with the general conditions and the owner of the live stock, who will usually lend assistance. Having done this, he can outline definitely the plans of his trip previous to the time of starting. This is the only method by which the trip can be made to serve its purpose.

References.

The Live Stock Industry:

Annual Report, U. S. Department of Agriculture.
U. S. Census Report.
Beef Production—Mumford.
Profitable Stock Feeding—Smith.

The Beef Cattle Industry:

Circulars 163, 164, 169, 175—Illinois Experiment Station—Mumford.

History:

Types and Breeds of Farm Animals—Plumb.

Feeding and Management:

Feeds and Feeding—Henry.
Beef Production—Mumford.
Numerous Experiment Station Bulletins.
Farm Structures—Ekblaw.

Judging:

Live Stock Judging—Craig.
Purdue University Extension Circular 29.
Bulletin 78—Illinois Experiment Station.

MATHEMATICS AND LIFE—THE VITALIZING OF SECONDARY MATHEMATICS.[1]

By R. D. Carmichael,
Bloomington, Ind.

It is customary to think of mathematics as separated from the usual concerns of ordinary life. As conceived by many people it is essentially a sort of monstrosity of the human mind which has come to the place it now occupies only because there has been an unbroken chain of men from the remote past up to the present who are characterized by an unusual development of that part of their mental organism in which such a monstrosity may appear. How widespread is this feeling concerning the very nature of mathematics is usually not realized. Many of those who have the feeling harbor it in their consciousness only in a dumb sort of way. They have never so much as fashioned it into a conviction, but they unconsciously allow it to dominate their attitude toward the science of mathematics.

As teachers you will readily be able to illustrate this remark by many concrete cases from among your pupils. All of you know the boy or the girl who does his mathematics, if at all, only by mechanical processes which are remembered. Such a one knows nothing of the spirit of our science. He is trying to feed on a dead mathematics and to suck sustenance from its dry bones. Probably you have also frequently met the question as to why we study mathematics at all. This is a natural question for one who sees no good in it. You will have sympathy with the pupil's point of view if you remember how often the answer which he gets to his inquiry is a lame one. If a teacher hardly knows why he teaches it it is no surprise that the pupil is uncertain why he studies. If the program which we lay out for our schools is made almost, or quite entirely, without reference to the life of our students, which undoubtedly is often the case, then it is natural that the high school boys and girls frequently find but little in it to contribute to their life and interest.

It is painful to see a student who goes to the preparation of a mathematics lesson or to its recitation as to a hated task or to a place of punishment. It is painful to hear one say, "I can do everything else in the course, but I cannot do mathematics." When that is said there is something wrong; and I do not half

[1]An address delivered to the Kansas Association of Mathematics Teachers at Topeka on November 14, 1914.

believe that the pupil is usually at fault. I hear it in my freshman classes over and over again. Just now I do not care to assess the responsibility; but I do want to say with emphasis that such a thing could not be true unless there is an essential defect somewhere in our work. What sort of monstrosity is mathematics that bright boys and girls are unable to learn it? The trouble is not with the bright boy or the bright girl; the trouble is not with the science of mathematics; the trouble lies in the way in which you and I bring the two together.

At times one almost feels that we teachers have reached the practical conclusion that even elementary mathematics is essentially difficult in such a way that many are unable to learn it; that is, we unconsciously shape our work as if we also believe that our science is a monstrosity. If so, we have no right to complain when our pupils get the same feeling. The matter would not be so serious if the feeling were confined to our students as such. We expect the boys and girls to pass through stages of wrong opinion in their progress from childhood to maturity. So far the race has found no way to prevent this. But we have a right to demand that correction shall be made before active life is entered upon.

Now, it takes but a brief conversation with average people of good intelligence to bring out the fact that most of them have never really understood what mathematics is about. They have carried over into life the feeling of their student days that it is essentially a monstrosity. This would be a matter of no moment or concern to us were it not for the further fact that mathematics has a great and valuable contribution to make to the life and the character of these men and women, while from somebody's fault —is it yours or mine?—they have not garnered in this fruitage of their school days.

Life is fascinating; and whatever is close to life has also a charm and an interest for us from which no barrier can separate us, not even the barrier of difficulty. Our boys and girls do not fail to learn mathematics merely because it is hard. Does not the noble soul spring forward with a new zeal and a charm of determination when he learns that his task is a difficult one? What he demands to know is not whether a thing is hard but whether it has a value for life and for character equal to the demand which it makes upon his energy.

And our boys and girls and our men and women are measuring mathematics according to the way in which it stands such a

test as this. Are they right about it? Should they require of it the satisfaction of such a demand? Emphatically, yes. If it cannot meet such a test as this let it go to the wall, let it go down in defeat, let it bite the dust of shame that it has so tyrannized over the minds of men and demanded so much of their time and their soul's life without giving them a proper return. Everything we do should have an intimate relation to life and it should be done because of that relation; for everything which we are or have is summed up in life, whether it be a present or an eternal value; whether it be the happiness of a service or the pleasure of a moment or the destiny of an immortal spirit, its roots are laid deep in the life of daily experience.

Therefore I come to you today with a plea for the vitalizing of our mathematics. Let us bring it close to life. Let us make the boys and girls see that it is close to life. Let us put into the work and the character of the citizens of tomorrow the great present and eternal values which our science has gathered up into it as a heritage of six thousand years of effective progress.

We shall best be able to think together of the things which I desire to bring to your attention if I first speak briefly of certain important and leading characteristics of life and the human spirit. Naturally, I shall not attempt a complete analysis of these, since mathematics is not sufficient in itself for the training and developing of all activities of the soul. I shall therefore direct attention to some of those to which mathematics may best contribute. A little later we shall see how it may act for strengthening and building up these characteristics.

What is this life of which we are speaking? Is it merely an assemblage of conscious states following one another in the course of time and tied together by a thread of memory? Is it a transitory thing like the breath, destined to be active for a while and then to vanish forever? Or, is it something permanent, abiding, enduring, big with the issues of eternal things? These are the primary questions in all our great problems and must be answered consciously or unconsciously before these problems can be solved. We cannot determine what relation mathematics should bear to life, until we are agreed as to what life is. If one of us believes that it is fraught with eternal possibilities while another thinks that a man is no more than a sheep, we shall work to cross purposes in adapting any fundamental discipline to the needs of life.

Now there are those who still believe that these human activi-

ties have their basis in a soul and that it is in the quality of this activity and this soul that character consists. Here, they say, is the seat of man and he is something more than the collection of his conscious states. In fact, it seems to me to be true that those who have most profoundly analyzed the matter have come through to this conclusion. Human life is not merely animal existence. Life does not consist alone in the practical, in getting around among the things of this material world. There is an esthetic element in man and it is profoundly related to the whole structure of his character. There is also a moral nature in him and out of it spring the great motives of conduct and from it arise the great movements of progress. And there are eternal values which are not of today and tomorrow but are for all time. Let us briefly examine each of these four parts of our activity.

In the first place, life is a great practical concern and in every moment of it beats the throbbing pulse of a material world. Go where we may, choose what time we will, we shall find ourselves always and everywhere surrounded by crass materiality. Happy are we if we are not submerged in the stream of actualities and swept from our intellectual moorings. The first task of our intellectual progress was to get control of material movements and turn them to our use, to learn to get around in this world where there are stones to bruise us and obstacles to impede our progress, and to lay our hands on bread to sustain our bodies.

What is the greatest general problem of this practical life? What is the one thing which, if a man should obtain it, would cause each of these other practical things to be added unto him every one in its own place? The answer is in a single word—a new one, or rather an old one with a new meaning—and that word is EFFICIENCY. Here is the primary problem of the practical man—how to be efficient.

Turning now to a consideration of our esthetic nature, let us ask what is the primary concern of art in every form in which it is manifested. Does it not seek first of all to put the beautiful in the foreground of our meditations and to hold it there until it has been wrought into the tissue and fiber of our character and then to hold it there until it has built us up and made us into that beautiful thing which it is?

Back of every piece of art, and prior to its coming into existence, is the premeditation of the artist whose work it is. He must see the plan and the scope and the essence of the thing in a vision which transcends mere intellection and then by a grand

foresight he must see the means which will translate the vision into an actuality.

As premeditation characterizes the artist in the production of his work so meditation is the first necessary element in the enjoyment of it. What there is in it does not come to us in a moment or an hour. The soul of the artist is in it and if he be great it will take us years to read all that he has wrought into his story, his poem, his music, his painting, his sculpture, his architecture—because it takes years for us to absorb into our souls what the great artist has for us in his.

With respect to the third element of life to which I have directed your attention let us raise the following question: What is the characteristic basis of the conviction that moral virtue exists? We shall get at our answer by asking another question. Suppose that the world were a chaos and that events came by chance; suppose that there were no connections between phenomena and things were not working forward to an end or even so much as to the bettering of conditions; suppose that you and I had no control over ourselves and that our organism were subject to no law of action: then what could be said of moral responsibility and moral virtue? Clearly, there could be no such things. Hence the characteristic basis for the conviction that moral virtue exists is in the belief that law and order are to be found in the universe as a whole. Consequently man can be right only by bringing his acts into a harmonious relation with these laws. Hence arises moral responsibility and from ethics and religion the demand to heed the call of conscience.

Now, what about the eternal things that are related to life? I have already intimated to you that I have a strong belief in their existence. As you know, there are those who have the contrary opinion. The crucial point of the matter lies in this question: Does anything about human life endure permanently? If there are eternal interests and values there can be no doubt about their transcendent importance. Here is hardly room for controversy and therefore men have taken but little time to dispute about the significance of such things. But they have thrashed over and over again the prior question as to whether they exist. There are those who believe that everything is essentially transitory and that all things cease to be as soon as they lose this quality. We cannot take time to analyze this fact; it is sufficient to our purpose to observe it.

Referring to the four things which we have briefly examined

together it is easy to see that among them mathematics and life are connected in the most obvious and tangible way in the realm of the practical. Here we have to do with the ever-flowing stream of reality. We have to find the relations among things. We must know the laws which connect them. We are ever concerned with their various quantitative aspects. Fortunately for us several of the great controlling elements here are, for practical purposes, expressible in simple mathematical form so that by means of such expression we can see much further into them than we are able to sense by experience. When one looks about him and sees how many relations are essentially mathematical in their nature, and when he observes further how fundamental these are to the vast ramifications and connections among phenomena, it begins to come home to him with great force that the universe is mathematical, that God indeed geometrizes, as one of the ancients has said. Among all the ways in which men have been able to express the relations of external phenomena there is none other which compares in vastness and consistency with the mathematical. Witness such great provinces of applied mathematics as mechanics, celestial mechanics, theory of magnetism, theory of electricity, and theory of the potential, to mention a few of the leaders. It is just to say that the mathematical philosopher has here summed up into his doctrines the most essential and far-reaching elements of these central subjects and that each of them, under the magic of his touch, has been exhibited as a single body of doctrine united to and dependent upon a few fundamental principles and laws.

It is through just this power of subsuming much under little that mathematics gives us such a hold on the external world. At best our intellects are not able to grasp an immense variety of phenomena and hold them together so as to elicit from them the conclusions which they teach. We need to get them completely expressed into law and related according to this law. Then we are ready to use them for new conquests. It is through this fact that mathematics has enabled us to do so many remarkable things which we could not have accomplished except by its aid. What could the engineer do without the science of mathematics which enables him to make his plans and guides him in putting them into effect? How could large suspension bridges be safely built if our mathematicians had not taught us what curves to use? How could great tunnels or great canals be constructed without the direction of an engineer whose science is based on mathe-

matics? What are the theoretical parts of physics and astronomy but characteristic applications of mathematics? And even chemical analysis itself, is it not in its deepest researches based on and guided by mathematical abstractions?

Some of you have probably raised the question in your mind as to whether I am talking about things of the schoolroom, things related to secondary mathematics. I answer: Yes and No. Some things I am talking about you cannot make boys and girls understand; and some of their teachers have not yet learned about them. But the teacher who knows these wide ramifications of the subject will be able to drop suggestive hints to some of the brighter pupils so as to inspire them to far-reaching achievement. And I ask what greater thing can any teacher do than to awake a strong man into power? The greatest tragedy of life is the waste of power unrecognized by the possessor and his associates. I would that more teachers were filled with the burning desire to find out those who are strong and to give them into the service of mankind! Nothing you can do is closer to life than that.

But our most frequently recurring problem is not a great matter of this sort. On the other hand it is the greater thing which consists in unbroken attention to small details. Our girls must learn the mathematics needed in dealing with the grocer and the butcher and in buying a piece of cloth. Our boys must know how to measure lots or to lay off farm lands or to compute the dimensions and relations of the various parts of a machine or the areas of land or the contents of barrels and buckets and boxes. They should be able to grasp the geometric relations of houses or bridges or other structures or to lay out for themselves a plan for the back steps or a roof for the chicken house. Both the boys and the girls should know how to lay off walks and to estimate their dimensions and areas according to any one of various purposes which they might have in mind.

These are a few of the practical matters to which our elementary mathematics may be related. There are a hundred and one others. It is not our purpose to go into an enumeration of them. In this address it would be impossible even to outline a program by which they are to be wrought into our courses. That is a problem for the curricula makers. In passing I may merely express the conviction that they are to find a larger place than they have held heretofore. In the years immediately before us many teachers will analyze the life of their pupils in order to ascertain what kinds of problems they will need to solve and these when found will be put into the courses.

If you have been thinking of the high school curriculum in mathematics as related to these practical problems you have observed that it contains many things not intimately related to the detail of daily affairs; and probably you have asked whether our doctrine that all things taught should bear directly on life will operate to exclude all these matters from the curriculum. The answer is an emphatic negative. The way in which certain subjects are sometimes taught renders them ineffective for eliciting the pupil's interest and for the accomplishment of any useful end. That means that we need a reform in the methods of the schoolroom and not always that the matter should be thrown overboard. We prefer to make Jonah a new man rather than to give him up to the whale.

But how are we to vitalize the things in which the pupils now detect no close relation to life? A complete answer to this question would be a panacea for all our pedagogical ills. You cannot expect that much. Hence a partial answer is all that I shall attempt; and this I shall associate with the idea of efficiency, in which is involved, as we have seen, the greatest general problem of the practical life.

Now it will be admitted once for all that the mastering of mathematical difficulties has no general contribution to make towards an initiative for the efficiency of the individual. But suppose that we have a boy or a girl who has realized the value of efficiency and is actually going about the task of attaining it, having in mind some specific methods for his individual development. It will be granted at once and by every one that it is a matter of great concern to this boy or girl to have an effective means for ascertaining whether or not he has yet reached the state of efficiency. It is here that mathematics may come in. The demands which it makes are clear-cut and there is a sharp cleavage between success and failure in meeting them. Moreover the proportion or percentage of success may be determined with a large degree of accuracy. Therefore, as one cannot fail to observe, there is great opportunity for the teacher to lead the pupil to see, among other things in his mathematics, a means of testing himself day by day as to the power he is developing and the efficiency he is attaining.

But many of us are not properly using our work to this end; perhaps few of us are. Maybe the possibility has not occurred to some of us and that is why we have not realized it. Perhaps others have been hindered by the heresy which teaches that special

exercises do not train general faculties, whereas the wise instructor can always bring permanent good out of that which is special and apparently only for the moment. But whatever the cause the fact remains. I plead, therefore, for the recognition, in the mathematics room, of the call of the world for efficiency. Let us make the boys and the girls know the difference, in this one thing at least, between efficiency and inefficiency.

Turning to another phase of our subject, let me call your attention to the fact that mathematics is a great work of universal art. It has for the creator and the beholder the same fundamental characteristics as other special works of art. In order that he who looks upon it may appreciate it he must look intently and meditate for a long time, just as in the case of a man who enters into the spirit of a picture or of a poem or realizes the soul of a builder who constructs a magnificent edifice. Likewise, before such a work of art can be constructed there must be much premeditation on the part of the makers. It cannot be wrought out by a single individual or even a single generation. Consider that magnificent piece which we call algebra. It has been three thousand years in the making and there are yet other touches to be put on and beautiful additions to be made. While old with the ages it is yet new with life like every other great division of our subject. Truly mathematics maintains its characteristic as art in being universal and for all time.

How much of this shall we try to make our pupils understand? Only a little, but that little is of value. Can we not induce them to see what a beautiful work of art is elementary geometry with its great array of consistent theorems all based on a few axioms? If the teacher has a deep appreciation of this subject and knows how profoundly the existence of this body of doctrine has affected human philosophy and science the overflowings of his enthusiasm will fill some niche in the soul of his pupil. No music, no poem, no painting, no other work of art, gives me a greater sense of the beauty of harmony than a well-developed body of mathematical doctrine; and I cannot avoid the feeling that there are many boys and girls who are able in some measure to add the same pleasure to their lives. If one is deprived of every special sense and has seen but a single mathematical structure as a work of art he has something left for his esthetic meditations as long as he possesses a mind to think.

Now we have seen that the characteristic basis of the conviction that moral virtue exists gains its strength from our assurance

that law and order are to be found in the universe. Now, where do we best observe law and order? It is precisely in the realm of mathematical abstractions. But there are many souls, and noble ones, to whom abstractions make no appeal; and consequently we shall not speak more of these. As to the existence of law and order in the concrete world of material experience there is no stronger evidence than that afforded by the various subjects of applied mathematics. When we see an immense number of phenomena completely explained by means of two or three simple laws, by aid of which their occurrence can even be predicted, we have a feeling too strong to be overturned that the things of nature are actually bound by law. These general considerations are beyond the reach of high school pupils. But it is possible to give them a foreview of this vision. We can call their attention to some classes of phenomena, say of motions, which are expressible by simple formulae. One case in point is that of falling bodies. Should we not work into our courses more of these laws which express the concrete facts of daily experience and give a part of our drill work in connection with them rather than with meaningless algebraic formulae?

Turning abruptly to another matter, let us ask what mathematics has to do with eternal things. The answer is short and simple. In this science there are eternal verities. Every algebraic equation, for instance, has a root now and forever. That the square on the hypotenuse of a right triangle is equal to the sum of the squares of the two sides is true independently of time and place, is a verity which cannot be questioned. Concrete cases of such everlasting truths should make some sort of appeal to our pupils and act as a ballast to keep the boat of life from being too violently tossed by the ever-changing form of all other scientific thought. This is particularly needful today, among more advanced students in the colleges and universities, in view of the extraordinary changes now taking place in general scientific theory.

This which I have now outlined for the teacher, with its ramifications into life in so many directions, can be undertaken and done only by one who loves his work and is enthusiastic about his science and the welfare of his pupils. To others some of the things which I have said will seem a vain babbling of words. But you who can see the vision of a mathematics touching life and thought and character and adding an element which can be gotten from no other source, have we not before us an ideal, for

which we may work, big enough that we can labor towards it for a lifetime and find something still to do? If you have beheld a vision like that, then I have accomplished my purpose in speaking to you. I have not outlined a program, for that is the work of deliberation and conference. But the things which we have considered together make it apparent that a new one is needed.

Ladies and gentlemen, you who guide the mathematics teaching of the great state of Kansas and make it what it is, a great responsibility rests upon you in this time when the world about us and our conscience are demanding new things of us. You are in the active period of your life now when there is much progress to be made. I trust it may be true, as I hope and believe it will, that the future will look back to this half-century as one in which there was great progress toward the realization of a larger general good from the study of mathematics.

MATHEMATICS AND LIFE.

By W. T. Stratton,

Kansas State Agricultural College, Manhattan, Kansas.

Note: This paper is a discussion of Dr. Carmichael's paper and was given at the meeting of the Kansas Mathematics Teachers, November 13, 1914.

In the first place I want to express my appreciation of Dr. Carmichael's paper and fully endorse most heartily everything he has said. He has covered the subject pretty thoroughly, however there are a few things about which I would like to speak briefly.

(1) *The value of the study of mathematics.* The fact that mathematics has held such a prominent place in the present school curriculum has a tendency to make teachers of mathematics feel that their subject must be of the utmost importance. However, if they were actually called upon to give in clear, concise language a statement of its value they would probably not be able to do it. The time has come I think when it is necessary and also good pedagogy for the teacher not only to know the subject he teaches but also to know something of the reason why he should teach it. In fact if a teacher knows, and can justify his reason for teaching his subject, it goes a long way toward determining his attitude toward the subject and how he will teach it. One of the greatest needs of mathematics today is a scientific determination of the

ends to be attained by its study. Teachers should have less blind faith in the supreme value of their subject. There should be a conscious purpose in teaching and a frequent attempt to measure results obtained. It makes a great deal of difference whether one is merely teaching the elements of mathematics, or is teaching mathematics as a tool for business life.

Students often ask their teachers why they have to study mathematics, or what is the value of the study of mathematics. I think that the student has a right to a fair answer and not be put off with the answer that some day he will see the value. He should be taken into the confidence of the teacher and given a free, open, frank discussion of the value of the subject and the reasons for its study. If the student is still not convinced the teacher has done his part and the pupil will have a respect for him that he would not have had if he had put him off until some other time or treated him as if it were none of his concern. The mere fact that a subject is in the course of study does not always justify it. If every teacher of mathematics in Kansas had a clear vision as to the value of the subject and then taught it with that keen insight that comes with the consciousness of doing a worthy work we would not have many complaints from the students against taking mathematics.

(2) *Needs of the different individuals.* It has been the custom in the past to overlook the needs of the different individuals and groups of students. We have been giving, with some few exceptions, the same courses in mathematics in all our different high schools. The boys and girls of the city high schools have been given the same courses irrespective of the industries in the different localities for which the larger number of them are preparing. The rural schools and those in the small towns have been offering the same courses without regard to the vocations which the pupils will likely enter. Democracy in our mathematical teaching does not consist in giving the same courses to all regardless of the tastes, capabilities, and the things for which they are preparing. As long as such a small percentage of our high school students go on to college we should not adjust our courses entirely to suit the needs of those who do. The great number of boys and girls do not go into professional work but go either from the high schools or the grades to the farm, the store, or the shop. In view of this fact their mathematics should be of such nature as to prepare them best for the work they will likely do. I know that such a thought makes the mathe-

matics teachers in general shudder. They believe that mathematics is too sacred a subject to be allowed to cater to the needs of the different communities, or to be put upon a commercial basis to any extent whatever. However, I believe that in a community where the boys and girls are getting ready for work in the shops the course in mathematics should present the problems that will be of value to them and help them to make the best progress when they go into the shops permanently. The farmer boy should be able to handle the problems that come up to him for solution,—the problems that have to do with the transactions of his immediate business. Do not understand me to mean that mathematics should not be treated as a science. Mathematics should be treated as a science to be sure, but as a science applied to practical living; it should be made to function in the lives of the pupils. Mathematics which takes up theorem after theorem without a thought of how its results are to be turned to practical account in the acquisition of knowledge in the other sciences or in a practical way will certainly be of questionable value to the students. The value of mathematical knowledge to the majority of students in our secondary schools lies in its applications.

(3) *What the general public considers a test of the value of mathematics.* I think Dr. Carmichael is right when he says that our boys and girls, and our men and women are measuring mathematics according to the way it stands the test as to the value for life. This value is determined largely by the way our students apply the mathematics after they get out of school. One of the very common complaints against mathematics and one that is not confined to recent times is that the students cannot apply the mathematics they learn. The old time theory that a student will be able to apply his mathematics if he really knows it does not work out in practice. It is like a teacher who knows pedagogy and the theory of teaching perfectly yet utterly fails when he goes into the school room. His theory will help him to get experience much faster than he would without it yet it does not insure that he will ever be able to teach. The trouble is not with the theory but with the application. He would certainly be much benefited and less liable to make mistakes if he has had a chance to try out his theory under the direction of expert guidance. The same thing is true with the high school boys and girls in mathematics. They know enough mathematics to clerk in a store, make change, count interest, and so on, but they will

have trouble in doing it. The boy on the farm may know how to find the volume of a cylinder from data given to him from his solid geometry text yet he would probably have difficulty in working right off a problem involving finding the number of tons of silage a silo will hold, unless he has been given such problems at some time or other during his course. And so it is with all the other fields of application. Pupils are expected to apply their mathematics and after a good course we can reasonably expect that they be able to apply it, still we will all agree that they cannot do it as they should. The physics and chemistry teachers tell us almost daily that our students are not able to apply their mathematics in their sciences. A student may be good in pure mathematics yet he rarely ever has a clear notion of how to apply it. He takes hold of the subject as if it had no applications. If he has been given a chance to apply his mathematics he will at least get the idea that mathematics can be used and he will come to regard it as a valuable tool with which to do effective work.

(4) *Remedy lies in the selection of applied problems.* Dr. Carmichael stated in his paper that the most frequently recurring problem is not a great matter, but it consists of an unbroken attention to small things. Our boys must be able to solve the problems they meet in everyday life on the farm, in the store, shop, or wherever their lot may be. The girls must be able to solve the problems of the home, the office, store, or factory as they come to them in their everyday pursuits. Our mathematics will be made a part of their lives, it seems to me, when we present real and interesting problems with such skill and enthusiasm as has characterized our work during the presentation of "hound and hare" problems and other problems either entirely foreign to their interests or of a purely abstract nature. By interesting problems I mean those problems that are interesting to the pupils, by real problems, those that have been or will be met in the affairs of mankind which are solved in the manner it is proposed they will be solved. Applied problems may be real or they may illustrate some principles which may or may not have applications to life directly. The interests of pupils are not identical with the interests of adults and for that reason a great deal of care must be taken in selecting the subject matter. Teachers will almost invariably select the theoretical topics in algebra and geometry. For example in trigonometry the students will in general be interested in the applications of

the subject to the solution of the triangle. Most teachers will be more interested in developing the theory relating to the triangle. The student will more likely be concerned about how much time and work can be saved by using logarithms while the teacher will admire the many theoretical considerations which may be taken up with the subject. The student of arithmetic will only be interested in π from the fact that by making use of its value he can find the circumference of a circle when its radius is given, while the adult will be carried away with the beauty of the proof of the transcendence of π. This is not true of all pupils nor of all teachers and I believe that the interests of the pupils will be influenced by the teachers, but within recent years there has been a tendency, which I consider very commendable, toward a more careful consideration of the interests and tastes of the pupils.

Problems that touch the lives of the students and those that they think will come up in connection with their work later on will be of most interest to them. We have a good example of this in our work at Manhattan. Our engineering students are convinced that they ought to have their mathematics well and if they are not getting it as they should they will want to drop the subject and take it up another term. They are interested in mathematics largely because they will need it later on. They are interested indirectly at least from a dollar and cents point of view, hence they are spurred on to do their work. On the other hand the agricultural students are not so much interested from the practical point of view. Mathematics is needed for the work on the farm yet it is of a more elementary nature and the absolute success or failure of the farmer does not depend so directly upon mathematics as in the case of the engineer. The tendency, then, is to slight mathematics for something they consider will be of more value to them. The mathematics of the engineer makes up a very important part of his education which goes to make up his real life. It seems to me that in much the same way we can cause our mathematics to appeal to all our students. The committee on mathematics in the Technical Secondary Schools of the International Commission state in their report: "The experience of the vocational schools indicates that the solution of the problem of giving mathematics a better place in popular instruction and of reacting against the prejudices against the science lies in bringing the subject into such close relation with the activities of early life that a necessity

for knowledge of the subject is felt." Prof. Klein says: "The aim is not an increase in the amount of time given to mathematics but a reorganization of the subject-matter of the mathematical curriculum so as to bring it into closer conformity to the needs of the times, in particular by giving more time to the applications of mathematics and by laying less stress in the earlier years upon those abstract phases of the subject which tax the pupil's power."

(5) *The teacher.* After all the success or failure of the subject depends almost entirely upon the teacher. The teacher must have sympathy with the work and know the problems that confront the students of the particular school in which he is working. Good teaching requires time, care, and patience. Ideas are not fixed in a moment. They must have time to germinate. Care must be taken in cultivating the ideas so that vigorous growth is possible. Patience is needed to enable the teacher to frequently step aside and wait, for in mathematics especially the purpose of the teacher is to make himself useless to the class.

THE MATHEMATICS SURVEY OF THE CHICAGO SCHOOL SYSTEM.

By Mabel Sykes,

Bowen High School, Chicago.

In the spring of 1914 the superintendent of schools of Chicago conducted a survey of the Chicago school system. Among the various committees appointed was one on *Arithmetic in the Elementary Schools and Mathematics in the High Schools.* The report of this committee, together with those of the other committees, is printed in the Annual Report of the superintendent, a limited number of copies of which have been available for distribution in Chicago. Several points made in the report of the Mathematics Committee are of general interest to high school teachers.

The general opinion of the committee concerning the teaching in the elementary schools is expressed in the summary at the close of the report:

> "On the whole the committee found the teaching of arithmetic in the elementary schools good; far better than they had anticipated. They were struck by the great amount of careful individual work done and by the responsibility assumed by the individual child despite the large classes where much work is necessarily formal. . . . If the pupils do not get a reasonable knowledge of arithmetic in our elementary schools, the cause must be sought elsewhere than in the teaching in the schools visited."

The report gives the impression that the committee was not so well pleased with the work in the high schools. On this point two things might be said:

1. There were ten subcommittees each of which visited five elementary schools and but one high school. Any one sub-committee was, therefore, more competent to generalize concerning the work in the elementary schools than concerning the work in the high schools.

2. A series of visits to mathematics classes including the various grades from the second through the tenth, tends to support the following a priori judgment: Practically all elementary teachers have had normal training. Most high school teachers have not had. Therefore, about the only methods that the high school teachers know are the methods that were tried on them when they were students. Those that are most fresh in their minds are the methods of their college or university instructors—which are not always well adapted to ninth grade young people.

Two points under the heading, "Class-room Methods," are worthy of note:

1. The children in the elementary schools are accustomed to a great amount of mental and oral work while practically none of this work was seen in the high schools. It would seem that the high school teachers do not appreciate the value of mental and oral work as a pedagogical device. It has certain distinct advantages. Problems that are suitable for this work must of necessity be so chosen that the numerical manipulations do not obscure the reasoning involved. Oral and mental work affords a chance, therefore, to train pupils to give clear statements of the solutions of problems and to drill on some new or partially understood topic until the principles involved are mastered. It affords also the best means of discovering difficulties that may be either inherent in a given situation or peculiar to some individual pupil.

The committee appears to be of the opinion that power gained in oral and mental work does not of itself transfer to written work. If this is the case, much valuable time may be lost unless the teacher continually applies the oral to the written work.

2. There is a general tendency throughout the elementary schools toward keeping many pupils actively occupied and interested during the recitation. The report mentions various means by which this is accomplished. The chief difficulty seems to appear when the recitation consists of reports on previously assigned problems, especially when these problems are worked out upon

the blackboard by a few individuals and later read from the board by these same individuals. This criticism seems to be applicable to some upper grade arithmetic classes and to many high school algebra classes. Some scheme should certainly be used by which the entire class takes part in the criticism and discussion of the problem after it has been worked upon the board. As this work is often conducted the class is justified in assuming that it is not expected to do more than to witness respectfully the performance of the few selected at the beginning of the period. It may be that quite frequently the class time devoted to the report of home work should be materially reduced.

Some definite criticisms of high school teachers are given under the heading, "Handling of the Subject." The probability is that these criticisms are of general application and do not apply to teachers in Chicago any more than to teachers elsewhere. We venture to quote one paragraph:

"The tendency to be too abstract, to overestimate the value of mathematical manipulations was also visible in high school work. The questions asked by the teacher in algebra and geometry classes often indicated a superficial handling of the subject rather than a persistent effort to get at fundamental principles. The fundamental principle in the solution of algebra problems, namely, that one must find two things that are equal, was well brought out in one or two cases; in other cases the explanation stopped just short of the vital point. In algebra classes the committee noted a tendency to generalize too early, which resulted in a mechanical following of rules rather than a comprehension of fundamental principles. The distinction between what is the use of a certain operation in algebra or construction in geometry and what right have we to perform this operation or construction was rarely brought out in questions."

Something certainly appears to be wrong with our algebra teaching. It is astonishing and serious that a tenth grade geometry class can be almost entirely devoid of anything that suggests a real algebraic point of view, and that examination papers for university or normal entrance can be filled, not with pardonable blunders, but with inherently bad algebra.

This brings up the whole question of algebraic phraseology which was discussed in SCHOOL SCIENCE AND MATHEMATICS, January, 1914, by Miss Effie Graham. This question of phraseology is much bigger than the oft discussed use of *transpose, cancel, take out*, and the like. These phrases alone usually conceal considerable ignorance on the part of the children who use them. In cases like $(x-y)-a(x+y)$, the direction, "perform the indicated multiplication and subtraction" is much more definite in algebraic meaning than "remove" brackets, which has more or less of a mechanical sound. When a pupil is trying to factor

$a(x-y)-(y-x)$ he is often told to *change* certain *signs* so as to make it read $a(x-y)+(x-y)$. If, however, he really understands that $y-x$ is the negative of $x-y$, it is much more algebraic to say *instead of subtracting the negative add the positive.* The same criticism applies to certain statements that the textbooks make concerning changes in signs in fractions. $-\frac{a}{b}$ balances with $+\frac{a}{-b}$ because $-\frac{a}{b}$ indicates that the quotient $\frac{a}{b}$, which is positive, is to be subtracted while $+\frac{a}{-b}$ indicates that the quotient $\frac{a}{-b}$ which is negative, is to be added. A pupil who has been trained to *preserve the balance* at all times might possibly be led to see that he has no right to change $x^2-a^2-b^2-2ab$ into $a^2+b^2+2ab-x^2$ to suit his taste in factoring, or to drop the denominators when adding fractions. The common but atrocious statement $\sqrt{a^2+b^2}=a+b$ may be partly due to the fact that our phraseology does not convey at all times a definite algebraic meaning. The notation and the phraseology ought to suggest the operations and their order. If we continually spoke of one form as more convenient rather than as simpler than another, we might possibly get pupils to see that when they wish to find the value of $\frac{1}{\sqrt{3}}$, $\frac{\sqrt{3}}{3}$ or $\frac{1.732+}{3}$ it is much more convenient than $\frac{1}{1.732+}$. $\frac{1}{3}$ may be *simpler* than $\frac{3}{9}$ but it is not always more *convenient.*

The fact that we too often fail to get at the real significance of algebraic processes appears when we consider how generally pupils fail to appreciate that certain processes find their real meaning as the converse of certain other processes. The full meaning of the factoring of $ax-ay-bx+by$ as $(ax-ay)-(bx-by)$ $=a(x-y)-b(x-y)=(a-b)(x-y)$ does not appear unless the pupil appreciates that he is undoing the multiplications and subtractions involved in multiplying $(a-b)(x-y)$ thus; $(a-b)(x-y)=a(x-y)-b(x-y)=(ax-ay)-(bx-by)=ax-ay-bx+by$. Pupils too often fail to appreciate that division and the finding of roots are intimately related to certain forms of multiplication in spite of the facts that most texts treat these subjects in this way.

Some suggestions may be gathered from the report concerning certain difficulties of high school teachers.

1. *High school teachers complain that the children who come to them cannot study.*

The influence of the supervising force in Chicago seems to be against home study. This is probably true elsewhere. If, in addition to this, the curriculum in the elementary schools is so crowded that little or no time can be given to study during school hours the logical result is immediately evident. Under these circumstances pupils would reach the high school with practically no experience in study beyond what is obtained in the recitation itself. Pupils who have had no time for study must obtain their knowledge of the subject entirely from the recitation. The further consequences are also evident: When a pupil is called upon to recite he must keep the floor until he has mastered the situation or be seated, work it out and be called upon later. The "I don't know" would disappear from the recitation. When such a pupil reaches high school, therefore, he would certainly be inclined to feel that the teacher did not do her duty unless he received a mark of 90 or above with little or no outside effort on his part. The high school teachers may then be confronted by a situation which must be met squarely—not evaded nor made a subject of mere complaint. One way to meet this situation may be by the double period plan of one period of recitation followed by one period of supervised study. The possibilities as stated above may be extreme, but it certainly looks as if the tendencies were in this direction. It may be "up to us" to teach ninth grade pupils to prepare an assignment.

2. *High school teachers complain that the children who come to them do not know the most elementary facts.*

This is probably not true, at least not to so large an extent as is generally supposed. In a great many cases the high school teachers are not adequately acquainted with the work, methods and phraseology used in the elementary schools and are, therefore, as the report says, not able "to make proper connections." This matter of proper connections means considerable to immature minds. One illustration will suffice. One often hears it said that children in the high schools cannot add simple fractions. Much of the review of lower grade work that is done in the seventh and eighth grades is through oral and mental work. The high school teacher who begins by asking a ninth grade class to add $^{11}/_{21}$ and $^{17}/_{91}$ would probably get no response, but one who begins by calling orally for $\frac{1}{2}+\frac{1}{3}$, $\frac{1}{2}+\frac{2}{3}$, $\frac{2}{3}+\frac{1}{4}$, $\frac{2}{3}+\frac{3}{4}$, $\frac{2}{3}+\frac{1}{5}$, etc., would have her class enthusiastic in a few seconds. Exercises

like $11/21+17/91$ or $13/54+19/36$ are really more suitable for high school algebra than for elementary school arithmetic and are usually left for the attention of the high school teacher.

3. *The high school teachers complain that the children who come to them have not been trained to think.*

Barring the fact that in dealing with ninth grade pupils we are dealing with eighth grade, not university graduates, two points may be made:

a. The report deplores the "*insistent demands of business*" that the schools turn out "*expert manipulators of figures*" and continues,

"The ability to manipulate numbers rapidly is a power easily acquired, soon lost and easily reacquired when necessary. To put special stress on the acquisition of such skill or proficiency cannot but result in an irreparable loss in the more important phases of the subject and a sacrifice in the science of mathematics as a whole."

It is not to be supposed that the committee fails to appreciate the fact that a lack of ability to perform the numerical manipulations involved in any problem, may obscure entirely the reasoning involved in the same problem. The committee apparently merely wishes to guard against allowing the demands of those who do not know school children to over-ride what is really good judgment. It may be that a blind compliance with the "*demands of business*" is resulting in loss to the children.

b. The report states,

"That it is the opinion of the committee that if mathematical forms and language were more carefully exact throughout, time would be saved and power gained,"

and discusses mathematical form in some detail. It is evident from the discussion that problems can be set down so that the eye aids the thinking, so that the "logic of the problem is in evidence rather than the mechanical work." Some good illustrations are given; seventh and eighth grade pupils were found using such forms as,

$$\text{The area of a circle with radius } 27 \text{ inches} = \frac{27\times 27\times \pi}{144}$$

$$\begin{cases} \frac{4}{5} \text{ of the money} = \$1.20 \\ \text{the money} = \frac{5}{4} \text{ of } \$1.20 = \$1.50 \end{cases}$$

$$\begin{cases} \frac{4}{5}\,m = \$1.20 \\ m = \frac{5}{4} \text{ of } \$1.20 = \$1.50 \end{cases}$$

$$\text{Cost of 24 lbs. of butter @ } \$0.42 = 24\times\$0.42 = \$10.08$$

$$\begin{cases} \text{cost of 1 lb.} = \$0.42 \\ \text{cost of 24 lbs.} = 24\times\$0.42 = \$10.08 \end{cases}$$

This latter form is infinitely superior to

$$\begin{array}{r} \$0.42 \\ 24 \\ \hline 168 \\ 84 \\ \hline \$10.08 \end{array}$$

In the latter the "mechanical work is in evidence," in the former the "logic of the problem." The result of setting problems down in a form which throws emphasis upon the mechanical work is that

"pupils do much indiscriminate figuring working without plan or if they have one, losing sight of it."

It may be that as the committee thinks

"one of the causes of the long step between the eighth and ninth grades is due to the difference in formulation or mathematical expression of problems."

As high school or normal school teachers we can so lay stress on this matter of form that it will be remembered over and above the details of our work when our young people themselves come to teach in the elementary schools.

COLLEGE CHEMISTRY FOR THE GENERAL STUDENT.[1]

By E. A. Strong,
State Normal College, Ypsilanti, Mich.

The material for the paper which I am about to read was suggested to me incidentally during a study which I have been making in recent years concerning the mutual dependence and natural boundaries of the several physical and biological sciences.

This material is of two sorts: First, more or less desultory conversations with, and communications from, teachers of physics in universities and colleges concerning the kind and amount of chemistry needed by a college student of physics; and, second, from the examination, made for another purpose, of a large number of students' notebooks in college chemistry. Such back-stairs methods of investigation are open to all sorts of objections, and I would be the first to discredit them, except as furnishing suggestions for further study. Most of this material was collected at the east during my summer vacation; little came from my own state; though I have no reason to think that conditions east and west are very different. Partly owing to the desultory character of this material, and partly in the interest of brevity, I will not attempt to discuss this material in full, but will allow myself the always hazardous liberty of giving some impressions derived from it.

It has, then, been borne in upon me that the enormous expansion of chemical instruction in these latter days has, to the general student, brought some evils—especially a desultory habit of mind and some tolerance of shallowness and inaccuracy. In a word, this general student has endeavored to cover too much ground, and this ground almost entirely outside the boundaries of the old chemistry—*the chemistry of reactions*—where his main interest lies. He entered classes in chemistry to get that which is most distinctive of chemical science rather than in the outlying fields and along the rapidly extending boundaries of this great subject. Sooner or later he will take courses in physiology, physics, bacteriology, etc., where he will get at once more extended and more consecutive work than he can hope to get in a year's course, mainly devoted to applied chemistry. He needs chemical experience, and some exact knowledge of chemical fact and chemical law, and failing in this it is of little account that he has spent much time and found great interest in winding

[1]Read at the November, 1914, meeting of the C. A. S. & M. T. held at Hyde Park High School, Chicago.

dynamos, testing galvanometers, determining physical and optical densities, making "the bacterial count," and working with calorimeters, radiometers, osmometers, and that sort of thing. Richards in his address before the chemical section of the A. A. A. S., in 1898, complained that important fields of study had been neglected by both physicists and chemists because they happened to lie on the borderland between physics and chemistry. And what is true of research is also true of instruction. These important subjects are not well taught although the chemist, the physicist, the bacteriologist, the physiologist and the astronomer all have a hit at them. But my point now is that the attempt to do a little work with them has resulted in a loss of that which is most vital in chemistry.

But is there such a character in our colleges and universities as a general, or non-technical, student? Most assuredly there is. I have no complete statistics, but what I have been able to learn about certain classes in certain colleges has given me a strong impression that more than one-half the students of chemistry in our colleges, and nearly one-half in our universities do not intend to follow any chemical industry for a livelihood. They take chemistry as a part of a general education. Nor does it seem to me that they are ill-advised in doing so. Where, indeed, can the non-technical student—the intending business man, artist, or professional man—come into sympathetic contact with the scientific methods and aspirations of the time and feel the pulse-beat of modern life more truly than in the chemical laboratory and lecture room? There is a chemistry—an entirely noble chemistry, I hasten to say—of dollars and cents. The chemical laboratory has always kept open a well-worn path to the patent office and the employment bureau. But there is also a chemistry of culture—a chemistry which is an essential part of civilization. Nor are these aims—the technical and the culture aim—necessarily so far apart as is often represented. Very clearly differentiated in the abstract, they yet often blend and interpenetrate in the individual man. But where these two aims conflict the technical aim should undoubtedly rule—especially in the university. If any one is to suffer from badly arranged courses of study it is the general student. But need he suffer? Are not the very conditions which at present render this splendid discipline of so little use to the general student equally unfortunate for the technical student? My point is this: The general student will have but two years in chemistry—possibly only one—following

a high school course. Does not the student of applied chemistry need quite as much time as this upon systematic chemistry as a preparation for his special work? At present it is customary to hasten the work in the principles; give a brief course in qualitative analysis; add some work in titration and quantitative analysis and press forward to the special fields of applied chemistry. Often these special fields—physical, industrial, physiological, etc., chemistry (there are some ten or more divisions of applied chemistry) are brought in from the beginning and systematic chemistry made an incident to this instruction. In the hands of a master and for the special student this may be a safe procedure, and surely it leads quickly to the very heart of some special field of work. And yet for most students such rapid work breeds narrowness and confusion.

I am not pleading for a rectification of the boundaries of chemistry. A classification of the sciences on the basis of some abstract principle and a thorough delimitation of the field of each is always an interesting exercise in logic but can have but little interest for the practical chemist. For him chemistry is the chemistry of the journals—the chemistry of the laboratory and of literature. It is a commonplace of pedagogy that each of the historical subjects of study may be so defined and taught as to embrace all the others. The rather futile studies of a few years ago concerning concentration around some organizing center worked upon this basis. And for the technical student who sees a long road ahead of him in his special subject it is perhaps reasonable that he should get his English, his mathematics, his biology, his physics, etc., incidentally along with and as a part of his chemistry. This indeed is the tendency of the time. A university lecturer not long ago opened his second year's course with the words: "Gentlemen, our science is having a tremendous expansion in these latter days. Physics, Geology, Physiology, Biology and Engineering are only subdivisions of the broader science of Chemistry." The lecture notes of the students, referred to in the early part of this paper, all bore witness to this tendency. One set of books contained the expression, evidently quoted, under the head, Industrial Chemistry: "All industry is chemical industry," followed by notes of lectures upon the gas engine, the Diesel engine, dynamometers, speed and reversing gears, aeroplanes, and drilling and hoisting machinery. Another set of notes included lectures upon The Smoke Problem, Ventilation; The Automobile Traffic; Cement; City Parks, etc. Latterly in

some institutions chemistry has taken over the entire department of The Household Arts. And this notwithstanding the fact that "The Servant in the House" is a physicist every day and all day long; and that she is never anything else. It is true that her physical activities bring into play many chemical and bacteriological reactions, and it is also true that many of these physical activities have little significance, while some of the bacteriological and chemical reactions are of mighty significance and deserve large attention. But to sweep all this material into one heap and to label it chemistry—to regard work with pumps, sewing machines, vacuum cleaners, washing machines, gas and electric meters and motors, and the myriad contrivances of the kitchen, laundry and sewing room as chemical operations, is to put a premium on intellectual confusion. The case is different with the technical or research chemist. He follows his prey wherever it leads him. The question of boundaries has no meaning for him. But for the general student who comes into the class to get the special mental reaction of this subject it is unwise to go so far afield.

My purpose is not reactionary. Instruction in chemistry has greatly improved in the past few years. I do not count my own work in the forties and fifties of the last century, though it extended through more than six years and was taken under some of the masters of that day—still honorable names—Youmans, Clark, Joy, Chandler—and in two of the best secondary and collegiate laboratories of the time, as worth more than four or five years of the chemistry of present day. Improved methods of analysis have been introduced; the course has been condensed and rendered far more interesting and practical by the introduction of examples from daily life; the ionic theory has been introduced to explain reactions, indeed the entire science has been rejuvenated. My complaint is that the science has lost the old unity and continuity, has gone far outside its old boundaries and become a sort of circle of the sciences, or a kind of advanced nature study.

Now what can be done? With much hesitation I suggest:

1. Follow a good manual—and we have many excellent ones —not slavishly but with reasonable rigor. I find, indeed, some manual in the hands of practically all students of chemistry, but it is not followed except in the most desultory way, the last half being often slurred over.

2. Insist more fully upon some sort of sequence of the

sciences. Systematists incline to place chemistry after physics. Personally, I make no point of this order but hold some consensus of opinion and practice desirable, together with a reasonable conformity to the prescribed order. At present, both in school and college, freshmen, sophomores, juniors, and seniors will be found side by side in the chemistry classes.

3. A considerable amount of physical chemistry, industrial chemistry, etc., is chemistry in the strict sense and may well be incorporated in the general course and taught in a consecutive instead of a desultory way.

4. The chemistry of particular substances, especially those of common occurrence and large use, deserves more attention than is usually given it. The general student has a right to some familiarity, both in lecture room and laboratory, with substances which he sees all about him and finds mentioned constantly in the public press. This is often decried. What the general student needs, it is often said, is a knowledge of principles. True; but he needs to come to chemical principle in the only real way through chemical fact. The man who knows little chemistry in particular is not likely to know much chemistry in general.

5. As a particular case of the above, it seems to me that the chemistry of the so-called rare metals deserves more attention than is usually given to this part of the work.

6. Most important of all, we need some commission to partition among the several sciences those outlying subjects that are now treated so hastily and in such an elementary manner by each science in turn.

To illustrate, the thorough treatment of the balance—its theory, care and use—at present very ill done, might be assigned to the chemist. The so-called gas laws, very ill taught at present, might also be given to chemistry. Physical density and optical density and all fundamental work with refractometers, hydrometers, etc., might be the special work of the physicist. The same might be done with the measurement of heat and all work with calorimeters for solids, liquids and gases, at present very ill done. Work with colloids and the general subject of osmosis might be given over to the biologist, and so on through these outlying subjects. This would do away with a double or triple equipment of very expensive apparatus in the same institution, would allow the purchase of better apparatus, and would provide for a more leisurely and fundamental treatment of many important topics.

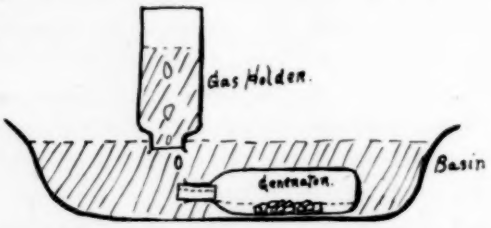
Chemistry is in herself a science of radiant beauty and power,

and least of all sciences needs the adornment of shreds and patches from other fields. We think of her always as resplendent and triumphant in her own right. There is in the British museum a Greek coin, of the best age of die-sinking, representing Alexander about to enter upon the conquest of the east. His head is raised, his hair is blowing back, and his eye is lifted as if it held the east in fee. This is our image of chemistry. We may well hope that our science will not also be like Alexander, bent upon foreign conquest while the homeland—poor little Macedonia—be left neglected and forgotten.

EXPERIMENTAL CHEMISTRY SIMPLIFIED.

By C. C. Kiplinger,
Iowa State College.

The following suggestions in experimental chemistry were selected for the purpose of aiding students who have no access to a chemical laboratory. However, present abnormal market conditions may render them of interest to the laboratory instructor



who finds his supply of glass-ware in a state of depletion. In fact, the writer has substituted these procedures for the conventional methods in his secondary school work with the result that there has been a lessened tendency toward obscuring the true object of the experiment. No expensive glass-ware or rubber tubing is needed. Although the experiments are of necessity very simple and qualitative in nature, much pleasure and intellectual stimulus may be derived from them.

Hydrogen: Hydrogen may be prepared by replacing the hydrogen of an acid, dilute hydrochloric or sulphuric, with some metal such as zinc. The apparatus, which the writer believes is new, is illustrated in the figure. The gas generator consists of a three or four ounce medicine bottle. A groove is cut in the side of the cork running the entire length, so as to allow means

of egress for the gas when the cork is inserted in the neck of the bottle. A few pieces of zinc should be put in the bottle and covered with a small amount of water. A little concentrated sulphuric or hydrochloric acid should be added cautiously. When the evolution of gas becomes sufficiently rapid, insert the cork with the groove opposite one side and place the generator in a pan, shallow basin, or crock partly full of water. The latter serves as a pneumatic pan or trough.

The generator should never be more than one-third full of liquid. The gas pressure prevents the water in the trough entering the bottle. Care must be taken to keep the groove open at all times. Wide mouth bottles or tumblers filled with water and inverted in the pan serve as gas holders.

OXYGEN: The same apparatus is used as for the generation of hydrogen. The bottle is filled to about one-fourth of its depth with a saturated solution of potassium permanganate. A small amount of concentrated sulphuric acid is added. The gas evolved is collected. The reaction is accelerated if the water in the pan is warm.

CARBON DIOXIDE: Carbon dioxide may be made in the above generator by using limestone or marble and dilute hydrochloric acid as reagents.

HYDROGEN DISULPHIDE: The same generator is used in the preparation of hydrogen sulphide. The reagents are iron sulphide and hydrochloric acid. The iron sulphide may be made as follows: Procure a clay pipe, some flowers of sulphur, and iron filings. Fill the bowl of the pipe with a mixture of two volumes of sulphur to one of iron filings. Cover the bowl with a small square of sheet tin and bring to a high temperature in a hot flame. The stem of the pipe serves as a handle for this extemporized crucible.

CHLORINE: Because of its solubility, chlorine cannot well be collected over water. Procure an empty bottle and a small piece of glass for a cover. Put a pinch of potassium chlorate in the bottle and add a few drops of concentrated hydrochloric acid. After a time, the bottle will be full of a mixture of chlorine and one of its oxides, which may be tested as desired.

NITROGEN: Nitrogen may be prepared either in the generator or as in the case of chlorine. The reagents are ammonium chloride (sal-ammoniac) and sodium nitrite, a small pinch of each, and a little water. Hold in warm water to start the reaction.

Other methods of working fully as simple as the above will suggest themselves to the experimenter. Large pill or sample bottles of thin glass serve for test-tubes. For heating articles of thick glass to temperatures higher than that of boiling water, the use of a paraffin bath is suggested. The amount of work which may be done with such crude materials is certainly surprising.

THE PURPOSE OF POLITICAL GEOGRAPHY.[1]

By Walter S. Tower,
University of Chicago.

The study of geography commonly is recognized as a necessary and valuable part of a general education. For this reason one phase or another of the subject is taught in the various stages of educational development, from the lower grades through all the years of university study. Each branch of geography has its own claim for recognition, but it is doubtful if any branch can present a claim stronger than that of political geography.

The commonest reason given for the teaching of geography, both in schools and in colleges, is that a knowledge of the world in which we live is essential, not only for an understanding of what is going on about us, but also for the discharge of our obligations in good citizenship. Political geography, perhaps more than any other phase of the subject, goes farthest toward these objective points. Yet real political geography now is taught in this country less generally than any other phase of geography.

The reason for this neglect of a most valuable part of geography apparently lies in the fact that few people seem to grasp clearly the meaning and purpose of political geography. At the same time, it may be noted that among those who do appreciate the value of the subject, there is some tendency to regard political geography as suited only for students of college grade. It is the object of this paper to discuss the purpose of political geography, with the idea that it may be generally recognized as a desirable subject for students below college grade.

One definition of political geography makes it "the geography of the different political units (countries, colonies or states) into which the lands are divided." The notion of the subject which is gained from such a definition varies, of course, according to the

[1]Read at the November, 1914, meeting of the C. A. S. & M. T. held at Hyde Park High School, Chicago.

individual interpretations of the word geography. Most people apparently think of a study which differs but little from the ordinary work in the grades, where a country always has been the unit for discussion, with its chief cities, large rivers, prominent mountains, staple products, principal industries and the like, as the items of major importance.

Let us consider briefly what this interpretation of political geography means, for this sort of geography has perhaps more supporters than critics, although its defects are many. Its purpose seems to be the *giving of information* about what there is in the various countries. It is, therefore, not infrequently concerned largely with unexplained facts, the teaching of which, if questioned, is justified on the ground that one cannot read or converse intelligently unless one knows about these places and things mentioned in the standard texts. To a certain extent this position may be right, but it becomes entirely indefensible when it leads to a notion that not to know the capital of Switzerland, or of Bolivia, and inability to name offhand the largest city of Saskatchewan, or of Tasmania, are sure evidences of ignorance. It is a rare person who can give offhand the location of such places as Fayal, Cayenne, Manaos, Batum, Batavia, Kashgar, Oporto, Bluefields and so on, although all are mentioned in the geographies and still figure prominently in the activities of their respective districts.

This condition recalls the common complaint that students fresh from the grades—in which all the countries have been studied—are ignorant concerning their own country and know nothing at all about others. Some allowance, however, must be made for the fact that many, perhaps most, of the things learned about countries (as the subject now is taught in the schools) are of such a sort that they remain unused and unthought of subsequently. It probably is true that if the average individual should think of his own age no oftener than he has occasion to think of the largest river in Canada or the chief city of Bulgaria, he would remember the one fact no better than the others.

The reason why many people know so little about the countries of the world, including their own, probably lies, therefore, largely in the number, the nature, and the application of the facts taught, so few of which subsequently can be applied often enough to resist the atrophy of disuse.

Since the object sought in the teaching about countries is so imperfectly attained under this foregoing concept, certain conclusions are obvious: the teaching is faulty; or the subject is

taught at the wrong time; or the subject matter is poorly chosen; or the wrong concept is being followed.

In a way all these conclusions are supported by facts. Too many teachers confine their work to recitations on the text. Any teaching which blindly and rigorously adheres to a text is likely to be faulty. In many places the study of the United States for example, is finished in the sixth grade. This means that after the age of eleven or twelve no chance is given to study the home country, except to the few who go into college and find there a course (usually elective) in that subject. No comment is necessary. The items chosen in the discussion of countries also are open to criticism. Thus it is very easy to put too much emphasis on places. Among those who are working intensively in geography few will deny that constant use of an atlas is necessary to refresh or verify ideas about locations. What, then, can be expected reasonably from the great majority of persons who have only infrequent use for most of the specific pieces of geographic information contained in the standard text.

The teaching of political geography in its true form would avoid these evils more effectively than anything else that might be suggested. Political geography does deal with countries as the units of discussion, but it differs in its underlying purpose from the geography which commonly is taught about countries.

Political geography is primarily not analytical, for its main object is not to take apart and reveal the character of all the component elements in a country. Where that sort of thing is done the attention is so fixed on the process of picking to pieces that little or no attention can be given to the inter-relationships of the different parts. The student rarely gains any very clear notion of what the whole nation represents. Hence the mention of Austria, Japan or Peru arouses no train of thoughts to recall the nature of those countries, because the parts never were fitted together when Austria, Japan or Peru was being studied. It is easy to take a watch to pieces, to see what the wheels are like, but it is another matter to make a real mechanical unit from the disassembled wheels.

Political geography is mainly synthetical, for its main object is to show how the various elements in a country work together in the life of the nation which occupies that country. The purpose of political geography involves an explanation of how geographic conditions have influenced (1) the creation of nations as they now are, (2) the relations of nations to each other, and

(3) what the different nations stand for in the world today. Obviously, to attain such a result, it is necessary to use much information about the essential parts of a country, but the teacher constantly must bear in mind the fact that the full purpose of the subject has been realized only when the parts have been fitted into a definite whole unit. Thus nations may be made to stand out, in all their important characteristics, so that the mention of Russia, for example, calls up some idea other than "the big yellow place on the map," or "the country where everybody wears long whiskers."

Let us take a parallel from botany. The ovary of the basswood makes an interesting topic for study, but however minutely it may be examined, it adds little or nothing to the student's idea of the tree itself. Furthermore, the average student will grow more and more uncertain about that ovary unless his original information is called into use frequently or refreshed by renewed observation, neither of which is likely to happen.

On the other hand, a clear impression of the basswood, as a tree and in its relations to the plant associations where it is found, once secured is much more likely to be retained. There are many things which may recall the appearance of the basswood, how it grows, and what its place is among its associates.

Basswoods are referred to more commonly than their ovaries. Japan is referred to more commonly than Tokyo. Repeated recollection is the high road to lasting memory. It is the life of the whole which is recalled most often, therefore the life of the whole is the most useful to know in the beginning and will be remembered longest.

Political geography aims to emphasize the life of the whole by studying the *nation* which occupies a country even more than the country itself. Therein, of course, is a vital point of difference from the common brand of discussion. Political geography may be said to regard nations as individuals, each with its own set of influences, some within, and some without the country, and each enjoying an existence largely modified or determined by these influences. This national existence is what is meant by references to the place held by a nation in the affairs of the world.

Obviously, not all the factors which influence a nation are geographic, but in most cases so many of the primary factors are geographic, that the significance of the others may be shown adequately simply by an enumeration of them.

When the underlying influences in the existence and activities of a nation are understood, country and nation may be thought of together in a tangible whole, the character of which will be recalled by every reference to its name. If the object of teaching geography is to impart some understanding of the world in which we live, nothing more useful can be done than to teach how geographic conditions have influenced the formation of nations, and are now influencing their activities and their relations to each other.

It may be worth while here to suggest some of the things which find a place in the discussion of political geography.

Among the larger aspects of the subject one finds a discussion of the factors which have influenced the division of the several continents in different ways to form countries. Thus it would become clear why Europe has more than twenty countries, whereas North America, more than twice as big, has less than half as many. It would then be shown how many results, vitally important to the countries concerned and to the world at large, have come from this difference between the two continents. Another part of the same discussion would explain why South America, Europe, Asia and Africa have their countries arranged around their borders, with more or less complex international boundaries in the interior, while North America has no such peripheral arrangement, but has most of its divisions stretching across from coast to coast. As a result North America countries typically have only two international boundaries, while three or more is the rule in other continents (Australia, of course, being an exception). European Russia, for example, has common boundaries with four other countries; France, with five; Germany, with seven; Brazil, with seven; and so on. The study and explanation of these conditions, from the standpoint of political geography, would go far toward interpreting the sharp contrasts in international relations on the different continents.

The distribution of countries according to their relative importance is another significant general topic. Few people really understand why Africa, the home of one of the earliest advanced nations, now contains almost nothing but little developed colonial territories, which more than once have contributed to friction between European nations. It is not generally understood why South America and Asia contain no nation which has undisputed claim to a place among those of first rank, why North America has but one, while Europe, smallest of all, has six na-

tions commonly regarded as belonging in that class. An appreciation of this fact, in all its bearings, is the one thing needed for understanding European affairs of the last four months.

Common, and perhaps the most serious, signs of ineffective training in geography appear in the misconceptions about what a given nation is and why it is so. Thus one frequently hears this or that nation described as "backward," "unprogressive," not likely ever to amount to much," and so on, because "its people belong to the wrong race," when as a matter of fact the real reason for lack of progress is not even remotely connected with the racial situation in the country. An acquaintance with political geography would remedy such erroneous notions, because the proper teaching of the subject involves the underlying reasons for the relative progress and importance of different nations.

Let us note now what material must be used in teaching political geography. These materials include a discussion of: (1) locations, in the world as a whole, in the continent and in relation to neighbors, large and small; (2) boundaries, as to extent, character and adjustment with respect to various interests; (3) size, as a vital factor in growth of population and extent of resources; (4) topography and climate; (5) natural resources, industries and commercial activities, as factors of great importance in influencing international relations; (6) population, as regards composition, distribution, density and occupations. The material, therefore, differs somewhat from that generally used in discussing countries, and it is used in a very different way.

In addition to these materials from the geographic side, the teacher must have at hand facts of economic and political history which illustrate the effects of the geographic influences at different stages of national development and in different phases of recent activities. When these two things, geographic influences and effects of those influences, have been put together the nations discussed appear as units, with definite characters. Furthermore, the student has an understanding of the world not to be had in any other way.

It would be impossible to deal fully with many of the topics of political geography in any of the years of school work where the study of countries now is done. In fact, it may be inadvisable in most of the grade years to try to deal at all with these topics, because they require more maturity of mind than is found among most grade students. But if left at the end of his school career without contact with the things which political geography teaches,

the student has been deprived of contact with a study of absorbing interest and denied information of first importance in knowing the world wherein he lives.

Most geography now taught is largely *the description of countries,* and this condition presumably will continue as long as the subject is confined to students between 8 and 14 years old. Political geography, as it should be, is the *geographic interpretation of nations,* and ought to find a place in high schools and normal schools as well as in colleges. High school students are old enough to grasp its facts; it would help them to recall, and so fix more securely, some of the facts first encountered in the grades; it would give them a knowledge of countries, at the time when maturer interests are developing, and increasing use for such knowledge will keep fresh for a long time the big facts of world geography.

It may be worth while for a child ten years old, chiefly concerned with toys and games, to know why the Japanese raise rice instead of wheat and corn, how rice is grown and so on. But it is worth infinitely more for the youth, ready to start life in earnest, to know how limited rice lands have helped force Japan into a policy of such aggressive expansion, and why this remote nation, hermit-like for centuries, must now be reckoned with in many interests of the United States. It is the purpose of political geography to explain such things.

A SIMPLE METHOD FOR SHOWING $a = v^2/r$ FOR CIRCULAR MOTION.

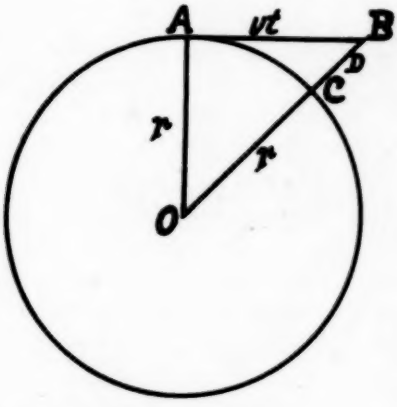
By L. T. Jones,

University of Illinois, Urbana.

If a body moving in a circle of radius r with a uniform speed v starts at A and is not drawn toward the center it will arrive in time t at the point B, distant vt along the tangent. If it is made to move in a circle, however, and the speed is uniform, it must be accelerated toward the center since force is required to change the direction of its path. The acceleration consists in a change of direction only and since it moves in a circle this acceleration must be constant.

Suppose the body, after passing A, travels for a short time t. It actually travels to the point C but if unaccelerated it would travel to some point B. If this time interval is taken very small the line OCB may be considered a straight line and the distance the body has been drawn towards the center is

$$D = OB - r = \tfrac{1}{2} at^2.$$



From the figure we see that

$$(r+D)^2 = r^2+v^2t^2. \qquad (1)$$

Substituting the value of D from the first equation we get

$$r^2+art^2+\tfrac{1}{4}a^2t^4 = r^2+v^2t^2.$$

Then

$$ar+\tfrac{1}{4}a^2t^2 = v^2. \qquad (2)$$

As the time interval is taken smaller and smaller the assumption involved in equation (1) is more and more nearly justified. In the limit, equation (2) becomes

$$ar = v^2,$$

whence

$$a = v^2/r.$$

PROBLEMS IN TEACHING PRACTICAL BIOLOGY.[1]

By Nettie Cook,
Springfield, Ill., High School.

With the popular demand to make everything in our high school curriculum serve the individual or the community, we find that the subject matter of biology must undergo some radical changes. In general there is no subject in the high school curriculum that can afford a more extensive field of material for better and saner living than biology.

In making these changes in the subject matter to suit the practical purposes of the student, educators seem to disagree greatly. Local conditions should govern to a great extent the selection of this material, but generally the pet hobby of the teacher is exploited. However, this controversy may come out in regard to the selection of subject matter, there are now in most schools certain lines of biological work that might be classed under practical biology. There has arisen too, in these schools, certain general problems in connection with this work which are worth the time for discussion.

In our high school, biology is not a required study. There are many high schools where the same is true. This makes the matter of election of biology largely a matter of popularity of the teacher. In some schools local conditions will increase the number electing the subject. This is particularly true of the smaller schools. But in the large city schools there still lurks that old superstition that Latin, French and History are the only polite studies to engage in. This makes only a comparative few who elect domestic science, manual training and biology as compared with the immense expenditures required to carry on these subjects.

Along with the fact that this old superstition in regard to value of studies exists, comes another fact about the present system of choosing subjects in high school. This does not apply to those schools where the first two years work is laid out definitely for the students. However, many elect their studies because their friends have elected those studies and they wish to be together in the same classes. In working with the freshmen during the past five years in advising them in regard to election of studies, I have seen whole groups of from ten to fifteen students elect a certain

[1]Read at the November, 1914, meeting of the C. A. S. & M. T. held at Hyde Park High School, Chicago.

subject because their leader did, irrespective of the fact that the principals in the grades had carefully made out their programs of studies according to their individual needs. This promiscuous election of studies in the first years of high school work, often finds the student coming in his senior year to the department of biology and asking that he be allowed to crowd in three years work in one. As a scientific body we should make an effort to see that high schools in our states are laying sufficient emphasis on the requirements in biology.

Another reason why the number electing biology is comparatively small is that as yet the biologist seems to have been too busy with his own personal investigations to exploit his work, or even to sufficiently inform the public as to the value of this work. The public schools must wake up to the fact that almost every phase of our daily life is governed by biological factors. How then are we going to present these facts? So far we have traversed only a short distance on this road of presentation of biological facts. We are still groping about on this road as though we had lost our way. Granting, now, that groups of students have made the election of biology, have overcome the prejudice against practical things, have seen the possibilities opened up in this work, we find that problems arise first, in the attitude of the pupil; second, in the administration of the school; third, in the attitude of the parent; fourth, in the aims of the teacher.

On this road of the presentation of biological facts, I mentioned before, there is one obstacle that looms up before the teacher in that students want to be bookish. If a textbook or lesson sheets are not furnished the students, they demand them with a much injured expression, as though the teacher were cheating them of their personal rights. Last year as a matter of experiment, I deprived my pupils of any text whatever throughout the year. This experiment greatly strengthens my impression that students are made more self-reliant, are better able to use reference work, and, of still more value, are able to use their own personal faculties. I loaded them down with individual problems to work out by themselves. This personal responsibility of presenting a subject to the class well worked out, was a remarkable stimulus to investigation. In my own estimation one problem thoroughly worked out alone by the student is worth more than all the dozens of problems conducted in the class room or laboratory where the student is propped up by the teacher, by manuals or by class room notes.

Another obstacle confronts us in the matter of notebooks. Too many notebooks are mere picture books. The student draws a figure to make a good picture, and frequently does not know one part of the figure from another part. There is a tendency to make this notebook, not a *notebook* but a treatise on a number of subjects.

Then again this notebook work may be mere copying from books, and does not represent the personal observations of the student. This has in it the element of dishonesty which grows as a seed to greater untruths, and practically defeats all the aim of science work. The matter of the large amount of time consumed in the production of a notebook has already been discussed at some of our previous meetings.

A wall which we have to confront and demolish is the lack of consecutive periods of sufficient length to accomplish any real work. Take gardening as an illustration. Two double periods each week are insufficient to accomplish anything in this line. Conditions of weather sometimes demand immediate attention to certain plants. Nature works continually, and many times the weeds get such a growth in the interim between laboratory periods that the allotted time is not enough to overcome them. On the other hand, plants need attention after sundown, and here again the pupil thinks his time his own. In some schools this sundown work is given over to a special school gardener. This defeats the purpose of the work entirely, since it does not represent the work of the student. There is, too, a general tendency on the part of the student to turn his work almost entirely over to the school gardener.

It is imperative that the attitude of those who have to do with the administration of school hours be changed, in order that the practical work in biology be carried out. The attitude of the student toward the time they devote to this work must also be changed. To study nature, we must work with nature. If during commencement week the country becomes infested with army worms, then is the time to study army worms. If plants have to be cared for during the summer months, students should be held for work at this time. These are everyday biological factors which must be met in the home life, why should they not be taken up in the school life?

The inclination of the teacher to want to help the student too much is likely to turn us back a long way on this road of teaching practical biology. It is the parent instinct of wishing to give all

the help that one can, which is very disastrous to the student. The teacher gets impatient to show results, and many times does most of the work. The idea that a certain number of subjects must be covered in a given time, is also disastrous to the best results from the student. Much of the work given at the present time is impatiently skimmed over, without the pupil obtaining the ability to utilize the material.

Another stumbling block in the way of teaching practical biology is the lack of co-operation of parents, and the lack of sympathy of the parents toward the subject. Perhaps sympathy is not the word to use, but rather information. The parents have very little idea of what is actually being done in our schools today. Recently a small boy asked his mother to show him how to do a problem in arithmetic. The mother looked at the problem and answered, "Well, I don't know what they are trying to get at, they didn't do these problems in my day." That was all the thought given the matter, and the boy refusing to consult his teacher, is still stumbling along not understanding a thing he is doing in arithmetic.

Most of the parents do not know what we are trying to do in teaching practical biology. We should work as hard to educate the parents as we do their children. Nearly all schools now have their Parents' or Patrons' Clubs. This is where the parent and teacher should talk things over. Too many teachers consider it a social club, where the mothers can get together for a little amusement.

We should acquaint the public about our work through the newspapers. The poor reporters are fairly desperate at times for copy. Give them something to talk about. This material will be surely more valuable than the tales of murder, the suicides, and much of the sensational news with which our papers are loaded. Let me give you a few personal illustrations.

One day, while walking along the street past the office of one of our local papers, a former student stepped from the office and joined me. He said, "I wish to thank you for the copy you furnished me the other day." I replied, "I don't understand." Then he explained how he had been hard pressed to write an article. After much thought he recalled his experiences in one of my classes where I had set him to the task of photographing all the leaves of trees he could find in the vicinity. This gave him a subject, "Use of the Kodak in School." This boy, who was considered a good-for-nothing in school, had found real pleasure in

much of his work in botany. He will no doubt be able to furnish many a subject for his work in journalism from this source of his experiences.

Last year our class in zoölogy began a campaign against the fly. We started out with the idea that advertising would be our main means of getting the campaign started, and we were right, for very soon the campaign seemed to fairly take care of itself. Students from the class made speeches before all the Patrons' Clubs in the city during the month of February. One of our prominent daily papers promised to print everything we handed in on the subject. The class working together wrote weekly articles that were spicy and interesting. These attracted such attention that other papers demanded articles on the house fly. An insurance company requested that they be allowed to print pictorial posters on the subject, and that these be distributed about the city. The Electric Company asked to be allowed to give away fly swatters. One of the local theatres presented moving pictures of the fly, especially for the school children. Later the various clubs of the city asked to be represented in the movement. Finally a federation of clubs was formed to make this campaign an annual event. But right here is where disaster came to the enterprise, for the work of last year at least. Two factions arose, each demanding that certain officers be elected and certain policies be carried out. The feeling waxed so strong that when officers were finally elected, and policies were finally presented, everyone was far too angry to carry out anything. This smacks somewhat of other campaigns in our national affairs where very little is accomplished for the general good. This all goes to show that even though the teacher interests the parents most keenly, the parents are harder to work with than the children.

Another illustration of the lack of co-operation from the parents: The students in our general science classes were given the problem of determining the general sanitary conditions of the grocery stores and the meat shops in the city. Several parents refused to have their children make this inspection. These parents were interviewed by the teachers and in some cases the teachers gained their point. It is interesting to note that in no places where inspections were made did the merchants object or oppose the inspection. In two grocery stores the students sent to inspect were thought to be state inspectors.

No objections arose from our tests made on purity and vitality of seeds. The students bought seeds from every store in town

where they could be obtained. They carried on their tests and tabulated their results. Two eminent seed houses requested that the results of our tests be sent to them as they wished to have their seeds rate high.

Frequently teachers fall into pitfalls of their own making, when they fail to see the purpose and scope of their work. Probably half of the teachers today are teaching to carry out college requirements. Some per cent of the other half are teaching for dollars and cents, and a small per cent are teaching to develop the child. The term, *practical biology*, sounds as if it were designed to develop the child, and at present we are trying to interpret practical biology as the science which makes for better living. We teach personal hygiene, sanitary conditions of the home and the city, plants and animals as necessary products, and finally we teach of those forces which war against these necessary conditions. I made a somewhat feeble attempt to determine what the general idea was among the biologists of the state, as to the exact aim of their work. My questionnaire did not meet with favor so I gave it up as a bad job. I happened to remember that for five years I had asked my classes on completing their work to write a brief statement of what they considered they had been able to gain from their study of biology, so I turned to these papers to see if any of my aims had been achieved in this work.

Here are some of the results obtained after consulting thirty papers taken at random from the pack which I obtained in the last five years. One student had been able to develop his brain power. Another had learned to be neat. Still another had increased his vocabulary. These certainly reflected the theories of some educators of an early date. I wondered if I had instilled these ideas. Two different students said they would be able to make classifications of plants and animals. Two others stated that biology had taught them not to be ignorant of common things. To quote the exact words of one of these pupils, "To distinguish different strange trees and plants of all kinds. The composition of different plants, the parts of all trees, grasses, vegetables, and flowers. This helps because if some one should happen to ask you the name of a certain kind of a plant, and you could not answer them, they would think that you didn't know much." Two other students claimed that biology satisfied their curiosity in regard to things. Again I questioned myself if I had belonged to this age of teaching. There was greater uniformity in the answers given by the remaining students. *Three* students

had discovered a purpose for everything on the earth. *Eight* students were better able to understand the meaning of life. *Nine* had found out how to take care of their bodies.

Quoting from one of these papers I find, "A knowledge of biology enables the student to appreciate more fully the value of the lower animals, and these facts create a feeling of sympathy toward all of God's creatures even though it be the dumb brutes, the insects and the beautiful birds which make life full and more glorious."

Sixteen students were better able to see things in nature, to enjoy the beautiful and to enjoy travel. One of these papers expresses the matter very tersely in these words, "The study of biology brings to your attention many things which you thought of as nothing, if you had thought of them at all."

Twenty-two students said biology had helped them to know how to be helpful to plants and animals so they might be kept from injury.

One student found that biology had enabled her to help spend the time while waiting for a car.

Last but not least one girl said she had learned how to grow sweet peas. Quoting from her paper we have, "Before taking up the study of botany I didn't have a very great desire to bother with flowers. Now I sacrifice some of my sleeping hours to water my asters, sweet peas, geraniums, and ferns. I really enjoy this work now. After transplanting my asters I tried dry farming which is working well."

This data may show how some of the aims I have already presented have filtered through the minds of my students. As a matter of experiment try this little method I have used to see how the aim of *your* work is reflected in the student.

Now that schools in general have come as it were to a parting of the ways where they must choose their pathway for an entirely new regime in high school work, let us as biologists use our utmost influence to direct the choosing of the pathway so that schools may require students to study more biology. Let us urge that schools no longer place the matter in the hands of the pupil entirely in regard to the selection of their work.

Let us carefully analyze the work of the pupil to determine whether there is a tendency toward "bookishness," whether the notebooks are mere picture books, as extensive treatises or copy work. Let us be sure the student is making the work his own. That the work is making him more self-reliant, able to use pub-

lic reference work, and above all is able to use to the utmost his own personal faculties.

Let us further urge as a scientific body that teachers advertise their work so that the public may know more fully how vital biology is to personal welfare. Let us endeavor to interest parents as well as students, and thereby obtain the time necessary to carry on the work.

Let us as teachers analyze our own work to determine whether we are aiming to produce weaklings in life, or whether these students will be resourceful, and able to cope with problems of the home and the community.

A USEFUL PIECE OF APPARATUS.

By Floyd L. Darrow,
Polytechnic Preparatory School, Brooklyn.

I have found the electric combustion furnace made by the Hoskins Mfg. Co., of Detroit, Mich., an exceedingly useful piece of apparatus for demonstration work in the teaching of chemistry. A two-foot length of silica combustion tubing is very desirable for use with the furnace. Following are some of the experiments that can be performed:

I. By placing iron filings in the combustion tube and passing steam over them large quantities of hydrogen may be easily obtained. You run no risk of breaking the silica tube by condensing steam in any portion of it and the silica is so poor a conductor of heat that the rubber stoppers used are but little affected by the high temperature of the portion within the furnace itself.

II. Atmospheric nitrogen may be obtained by passing air in a slow stream over copper trimmings. For producing the current of air I use a small rotary air blast driven by an electric motor.

III. Coal gas, coke, coal tar and ammonia may be obtained by the destructive distillation of coal. The coal tar may be condensed in a U tube immersed in cold water and the test for ammonia obtained with litmus paper, or this may be removed from the gas by a suitable gas washing tower. The hydrogen sulphide is tested for with lead acetate paper. The gas plant may be made as elaborate in its essential parts as the time and interest of the instructor permit.

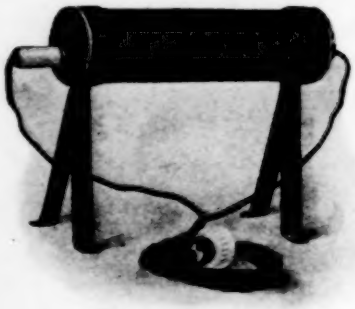
IV. The contact process for making sulphuric acid is easily demonstrated.

V. Water gas can be quickly made by passing steam over hot carbon.

VI. Carbon dioxide may be reduced to carbon monoxide by passing it over hot carbon, thus illustrating a chemical reaction of considerable commercial importance.

VII. Marble may be decomposed into quicklime and carbon dioxide.

VIII. Combustion of organic compounds is one of the important uses of the furnace.



The experiments mentioned above by no means exhaust the number for which the furnace may be used. The convenience of the furnace and the quickness with which it may be put in shape for any particular experiment are features which strongly commend themselves to the busy teacher.

A crucible gas furnace made by the Buffalo Dental Mfg. Co. I also find useful for making alloys, preparing quicklime and in some reduction experiments. With 20 feet of draft copper can be melted without the aid of a blower.

A Sand Filter.

In the bottom of an 8-gallon glass jar were placed five small inverted beakers to act as a support for a galvanized iron netting. On the latter was placed a two-inch layer of gravel and above this six inches of sand. With the sand and gravel was mixed alum and through the whole a considerable quantity of lime water was poured. Over the top two inches of charcoal were placed. A siphon going to the water reservoir at the bottom was inserted and the filter thoroughly washed. Water colored a deep purple by a dyestuff may be poured through the filter and drawn off at the bottom perfectly colorless.

Although a glass jar enables the pupil to see the process to better advantage, yet if this is not at hand an earthen jar can be substituted with just as satisfactory results.

HIGH SCHOOL DIETETICS.

By Ada Hillier,
High School, South Bend, Ind.

If the word dietetics meant exactly the same thing to each one, the discussion of the subject would be much simpler. As defined in the Encyclopedia Americano, it is that branch of hygiene that deals with the recovery and maintenance of health by right habits of eating and drinking. Miss Barrows says: "A practical course in dietetics would cover the source and manufacture of foodstuffs, the processes of cookery and wise combinations of foods, the calculations of dietaries for individuals, families and institutions, and the adaptation of foods to individual needs according to age, sex, climate and occupation."

According to the above definition, a course in general cookery would include practically all the points enumerated, except, perhaps, the actual calculations of dietaries, which Mrs. Richards defines as "a known amount of food of known composition per person per day."

Had I been asked a year ago when the calculations of dietaries should be introduced into a High School course, I should have said: "Any time after the first year," but since observing young and older girls working together I have come to feel that dietaries, figured out in all their minuteness of detail, should not be given before the Junior year, and by that time girls should be able to work successfully and understandingly.

From the very beginning of High School work, in fact, all through the grades, no food should be studied without the girl attaining knowledge of its source, manufacture and process of cookery adapted to its composition, and food combinations, in the High School not only the above facts should be learned but fuel values in definite terms of calories should be a distinct point, made along with the study of these other facts which can be accomplished by weighing out standard portions of all common foodstuffs, as they are used; combinations of these foods to make simple meals, with the energy value of each food and its adaptation to individual needs will give even the youngest girl a good notion of food values.

Dietetics of this kind may be introduced informally into the course of general cookery from the very beginning of High School work. This general course covering one year should be broad and strong, so that the girl will have a good working

knowledge if she can pursue this course only a short time, and at the same time form a good foundation upon which to build other courses should she continue in more specialized work.

The gram may as well be used as the unit of weight as the ounce, for as soon as these girls enter either physics or chemistry that will be the unit of weight they must use, so why not use it in dietetics?

After a girl has accumulated a scientific background, she ought to make a detailed study of dietaries. She is perfectly capable of calculating the energy requirement, the protein requirement, the cost, etc., for people of all ages, under all conditions, for she now has a knowledge of what it all means, and can see to what it will lead. Let her weigh foods of all kinds now, group them, and see the similarity of cost of the foods in these various groups; let her compare costs and food values and in a surprisingly short time she will be talking in terms of calories.

Interest will be aroused from the very beginning if she calculates her own dietary; first, let her estimate the energy value of the food she eats during an average day, as well as what per cent of it is protein. Then let her calculate what her energy and protein requirements really are, and compare them with what she does eat. This gives a fine opportunity to correct errors of diet, and when her figures show mistakes that her physician has already pointed out, she often begins a reform and gains a confidence in this new study that corroborates statements made by one whose opinion she respects. Let her modify milk for her baby sister, plan meals for the little brothers and sisters of kindergarten and school age, the growing boys and girls, and indicate all along the physical changes necessitating the changes in foods as well as other factors that would influence the character of the food.

Give them a very small sum of money from which they must feed a working man or woman and still keep up the requirements of the body—it will introduce economic and social problems and make them thoughtful of those less fortunate than themselves. After they have calculated a dietary at a very small cost, give them a very generous amount and they will discover that in order to spend so large an amount they must go beyond the requirements of the body and thus they learn that extravagance in food results in an indulgence that amounts to intemperance, and see that in time disease is sure to follow.

Along with all of this a strong review in food composition,

and emphasis on physiology of digestion will strengthen the course so that it cannot fail to be helpful.

The name dietetics may sound formidable to some girls; would a more commonplace name attract more girls to the course?

It seems to me that no girl can take a course in dietetics without having inculcated a splendid idea of economy—for has she not weighed out foods, and found that every teaspoonful represents a considerable amount of heat? She will respect her own body for she knows that she requires a given amount of food each day, if she indulges in more than that amount she understands the results and she also knows that if she does not eat suitable food she cannot do efficient work.

LAUNDRY WORK IN THE FLOWER TECHNICAL HIGH SCHOOL, CHICAGO.

By Elsie M. Garlick.

The girls who choose the four year course offered in the Lucy L. Flower Technical High School have laundry work for five periods a week during either semester of the second year. This work is given as part of the domestic science course, and the pupil does not take cooking during that time.

The first month's work is devoted to the discussion of stains and their removal. The chemistry of stains is very interesting to the average high school girl, and any correlation that can be made with other departments is made in all instances.

The articles for the demonstrations are brought in by the girls taking the work. Some time is given to the study of bleaching and the different fluids are made and used. By the time the girls have worked a few hours with the above subjects they have come to the conclusion that there is far more to laundry work than the mere mechanical drudgery of "washing and ironing."

Then too, in the meantime during the conference periods, discussions are given on such topics as "The Reasons for Taking Laundry Work in the High School," "The Qualifications of a Good Laundress," "Laundry Work in Different Countries," and "Development of the Processes of Laundry Work." After an hour devoted to the theory of washing linens and cottons in general, the first articles, napkins and towels, are brought in for practical work. There are several reasons why the above articles are chosen; first, they usually offer splendid opportunities for testing the knowledge gained in studying stains, second, they re-

quire no starch, third, they are less likely to be scorched (since linen may be ironed with a very hot iron and the girl beginning to iron is prone to use her iron too hot and iron over and over), fourth, towels and napkins offer good exercises in folding.

All articles brought by the girls are carefully mended before washing, and here again we correlate by utilizing most carefully the knowledge the girls have gained in Household Art.

Papers are written about the experiments with blueing, starches, soap and water. The lunch room and kitchen always supply us with grease, which is cleansed and made into soap.

Table linen, bed linen, lingerie, waists and dresses fill many lessons. After these follow laces, embroideries and curtains, then the work on woolens, which is usually the favorite topic with the class.

Some attempts are made at dry cleaning and at renovating velvets, and all too soon the time for the semester's close is at hand.

TEACHING OF FOOD THROUGH PREPARATION OF MEALS.[1]

By Agnes Wilson,

Housekeeping Center, Stock Yards District, Chicago.

Since home-making has become a profession it must have the same skilled labor that is required by other professions. More so, in fact, for the unskilled home-maker is more of a menace to the nation than a surgeon, or engineer, or carpenter, who lacks knowledge and dexterity. When the family is poor the problem is indeed great. Through ignorance of the simplest principles of hygiene the mother subjects her children to the dangers of an ill-cared for home. Having little or no practical knowledge in the buying and cooking of wholesome foods her family suffers from improper nourishment. Her children are probably anemic, run-down, if not tubercular. Her husband dulls his natural craving for good food and ordinary home comforts by seeking the saloon. Thus the breaking down of the family is begun.

To aid in the betterment of such conditions we have in Chicago two practical housekeeping centers modeled after similar centers in New York and London. A four-room flat is rented in the tenement district and furnished in an attractive and practical

[1]Read at the November, 1914, meeting of the C. A. S. & M. T. held at Hyde Park High School, Chicago.

manner which would come well within the income of the average tenement family. The entire furnishings amount to about $200.00. This includes everything—kitchen utensils, stoves, china, linen, furniture, etc. There is nothing in the flats that cannot be copied by the pupils in their own homes.

Here classes are held in the afternoon and evening. Children come after school and learn how to keep house properly, how to to cook inexpensive yet wholesome and appetizing food. They have lessons in scrubbing, laundry, cleaning—in fact in everything which pertains to the home.

Working girls, with a few married women, attend the evening classes. These are very successful. As it is rather difficult to obtain perfect attendance from a girl who is tired after a hard day's work or who desires amusement, the evening classes were at first a problem to me.

The typical cooking course is taught by means of separate dishes, one lesson given over to white sauces with creamed potatoes to illustrate it; the next to cream soups, etc. Judging by the attendance this method did not prove sufficiently interesting to the average girl. Moreover, unless there is a short dinner course given as the pupil becomes more advanced she will be at a loss when she attempts to combine the separate dishes and form a whole meal. And the fundamental object of cooking lessons is the preparation of a well-balanced meal.

At flat II the girls come directly from work and prepare their evening dinner. The general plan of a cooking course is followed as much as possible. At first the menus are planned by the teacher and are very simple, increasing in difficulty as the course advances. The work is distributed among the girls, each one preparing a soup one week, a hot bread the next, etc., until she has learned how to serve a complete meal. At the dinner table the furnishing of homes, food values, marketing, and other problems are discussed. The evening work is limited to two years. The children may attend two or three years.

At flat I classes have been held in the mornings for mothers who are pensioned, or receive supplies from the county.

At present this work is supported by memberships in the Association, gifts, etc. It is our hope that in time it will be carried on in co-operation with the public schools. As the influence of such centers is necessarily limited to their immediate neighborhood, they should be built in the school house or in a small building rented in the vicinity. By making the housekeeping a part

of the school curriculum and attendance compulsory, the work will become more definite. It will supplement the regular domestic science teaching in the school by practical demonstration, and will allow the working out and proving of the theoretical principles taught. I cannot sufficiently emphasize its effectiveness. Every girl has latent home-making instincts, which will be aroused by urging her to "play home" in a real house.

HOME ECONOMICS QUESTION BOX.

Buying of Food Supplies.

The following questions present topics which many teachers take up in household management or food work classes. The advantages offered by co-operating with the school lunch-room management in such a way as to afford the class opportunities for observation of methods of buying a variety of materials, are apparent.

Discussion of any of these questions by any teacher who is interested in some detail, will be welcomed by the home economics departmental editor. Particularly do we invite correspondence with regard to No. 10—results and conclusions reached by various groups under varying conditions, will be of general interest.

(It must be admitted that many of these questions are so constructed as to fit city market conditions much more closely than country or small town conditions.)

1. What is the difference in price per lb. between *leg* and *shoulder* of veal, at the present time, in your markets? Between rump, seventh rib, and crown roasts of beef? Between the ham bought as a whole, and raw ham bought by the slice? What are the reasons for these differences? How may we use each kind of meat?

2. At what season of the year are parsnips at their best, and why? Oysters? Grapefruit? Cranberries? At what times of the year do we get home-grown, and at what times hothouse celery? Cucumbers? Usual differences in price?

3. At what seasons, and under what circumstances, is it good economy to use "fresh" country eggs rather than cold storage eggs, for baking; for boiling or poaching? When are cold storage eggs equal to or preferable above the more recently shipped product? What are the reasons for different prices and grades of storage eggs?

4. In what size of can, pail, bottle or jar, and with about what net weight of contents, are the following foods (packed for household use) commonly sold: Tomatoes, corn, peas, lobster, pineapple, snowdrift, crisco, salmon, tomato catsup, baking powder, asparagus, pimentos, peaches, cherries? What average price would you expect to pay for such package, in what you would consider a high quality brand of goods? At this price, what is the actual price per lb. for food material, excluding weight of container, liquid (unless juice has real food value and palatability and can safely be used), and any refuse or waste?

5. Which of these foods do you buy "in bulk," and which prepared in some package form (carton, bottle, jar, can or pail): Apricots, molasses, sweet potatoes, olive oil, bacon, raisins, olives, hard candy, oatmeal, macaroni, dates, codfish, rice, beans, cornstarch, cornmeal? What differences in price, ease of preparation, palatability, sanitary and keeping

qualities do you find to correspond to these differences in preparation?

6. Give two examples of each of these kinds of baking powder, to be found in your local markets; cream of tartar, phosphate, alum. What differences in price? In method of using? Of palatability and wholesomeness in cooked products?

7. What is the cause of the difference between white corn meal and yellow corn meal; any choice between them, in your opinion, for different household uses? For the differences in price of Japanese, Carolina, unpolished, and broken rice? Name three satisfactory bread flours and two pastry flours to be found in your markets; price per 100-lb. sack, per 25 lb. sack, per lb., of each.

8. Examine marked pages in grocery catalogs from mail order houses, or marked grocery advertisements in city papers; select what you consider to be "good bargains," explaining how much you would save over the prices in local markets. Give good reasons in favor of, and opposed to, the practice of taking advantage of such bargains.

9. What are the different grades of milk, cream, butter, buttermilk, ordinary American hard dairy cheese, sold in your markets; price of each, variations in palatability, sanitary or keeping qualities which correspond to these differences in price?

10. What was the cost in money and time expended, of the fruit preparations which you preserved, canned, pickled, etc., this year? What would you have paid for a similar product in your local market? How many cents per hour does this give you for your work? How do the two products, homemade and manufactured, compare as to quality? (Use score card in answering.)

RECENT BOOKS ON ELEMENTARY SCIENCE.

In the December issue of this journal a list of texts and references is given in the article on Elementary General Science. This list was made almost a year and a half ago and is therefore not up-to-date. The following books have been recently published and those interested in general science teaching should be familiar with them because they are in many respects an improvement on earlier publications.

Caldwell and Eikenberry—An Elementary General Science. A general science reader without experiments, Ginn and Company.

Hessler—First Year of Science. A text, a laboratory manual, and a teacher's handbook, Benj. H. Sanborn Co.

Rowell—Elementary General Science. Book One. An elementary book of general science experiments, A to Zed School, Berkeley, Cal.

SPECIAL NOTICE.

At the November meeting of the Central Association, C. L. Manwaring paid dues but the Treasurer, H. R. Smith, 145 West Park Ave., Highland Park, Ill., has not his address. Will anyone knowing his address send it to the treasurer?

PROBLEM DEPARTMENT.

By I. L. Winckler,
Central High School, Cleveland, Ohio.

Readers of this magazine are invited to propose problems and send solutions of problems in which they are interested. Problems and solutions will be credited to their authors. Address all communications to I. L. Winckler, 32 Wymore Ave., E. Cleveland, Ohio.

Algebra.

406. *Proposed by the Editor.*

If $\frac{p_n}{q_n}$ be the last convergent in the first period of $\sqrt{A}$ expanded as a continued fraction, and r the integral part of $\sqrt{A}$, show that $p_n = rq_n + q_{n-1}$.

(Mathematical Visitor.)

I. *Solution by Norman Anning, Clayburn, B. C.*

If $\sqrt{A} = (r, r_1, r_2, \ldots r_{n-1}, r_n, r_1, r_2, \ldots)$ and if $\frac{p_n}{q_n} = (r, r_1, \ldots r_{n-1})$, to prove $p_n = rq_n + q_{n-1}$.

If the first period ends with the partial quotent r_n, it is known that $r_n = 2r$,

and $r_{n-k} = r_k$, $(k = 1, 2, 3, \ldots n-1)$.

Now $q_n = r_{n-1}q_{n-1} + q_{n-2}$

$$\frac{q_n}{q_{n-1}} = r_{n-1} + \frac{q_{n-2}}{q_{n-1}} = r_{n-1} + \frac{1}{\frac{q_{n-1}}{q_{n-2}}}$$

$$\frac{q_{n-1}}{q_{n-2}} = r_{n-2} + \frac{1}{\frac{q_{n-2}}{q_{n-3}}}$$

. . . . . .

. . . . . .

$$\frac{q_2}{q_1} = r_1 + 0.$$

From these $\frac{q_n}{q_{n-1}} = (r_{n-1}, \ldots r_2, r_1)$

$$= (r_1, r_2, \ldots r_{n-1})$$

$$\frac{q_{n-1}}{q_n} = (0, r_1, r_2, \ldots r_{n-1}).$$

$$\frac{q_{n-1}}{q_n} + r = (r, r_1, r_2 \ldots r_{n-1}) = \frac{p_n}{q_n},$$

$\therefore$ $p_n = rq_n + q_{n-1}$.

II. *Solution by the Proposer.*

It is known that the last quotient in the first period of the continued fraction is $2r$.

The fraction itself may be obtained from $\frac{p_{n+1}}{q_{n+1}}$ by putting $2r + \sqrt{A} - r$ in place of $2r$.

That is, since $\frac{p_{n+1}}{q_{n+1}} = \frac{2rp_n + p_{n-1}}{2rq_n + q_{n-1}}$,

$$\sqrt{A} = \frac{(2r + \sqrt{A} - r)p_n + p_{n-1}}{(2r + \sqrt{A} - r)q_n + q_{n-1}} = \frac{(\sqrt{A} + r)p_n + p_{n-1}}{(\sqrt{A} + r)q_n + q_{n-1}}.$$

Clearing of fractions,

$$Aq_n+rq_n\sqrt{A}+q_{n-1}\sqrt{A} = p_n\sqrt{A}+rp_n+p_{n-1}.$$

Equating coefficients of the irrational terms,

$$p_n = rq_n+q_{n-1}.$$

407. *Proposed by Jacob P. Santer.*

What three equal discounts are equal to a discount of 48.8%?

Solution by R. T. McGregor, Topaz, California.

Let x = the rate per cent of each discount.

a = the amount on which the discounts are given.

Then $a\cdot\frac{100-x}{100}\cdot\frac{100-x}{100}\cdot\frac{100-x}{100} = (1-.488)a = .512a;$

or $\left(\frac{100-x}{100}\right)^3 = .512;\ \frac{100-x}{100} = .8;\quad \therefore x = 20.$

Geometry.

408. *Proposed by Henry Smith, New York.*

If AB is a diameter of a circle, PQ perpendicular to AB from a point P on the circle and R is taken on AB so that AR = AP, show that QR is the radius of the circle touching PQ, QB, and arc PB.

I. *Solution by Elmer Schuyler, Brooklyn, N. Y.*

Let C be the centre of the required circle, x its radius, r the radius of the given circle.

Put a = AQ. C opposite Q is the vertex of a square.

Then $AP = AR = \sqrt{2ar}$.

$$\begin{aligned} r-CO &= r-\sqrt{(\sqrt{2ar}-a)^2+(r-\sqrt{2ar})^2} \\ &= r-\sqrt{(a+r)^2-2(a+r)\sqrt{2ar}+2ar} \\ &= r-(a+r-\sqrt{2ar}) \\ &= \sqrt{2ar}-a \\ &= QR = x. \end{aligned}$$

Hence the two circles are tangent, since the difference of their radii equals the distance between their centres.

II. *Solution by L. E. A. Ling, La Grange, Ill.*

Suppose K the centre of the circle touching PQ, QB, and arc PB.

From O, centre of given circle of radius y, draw OKE. Put OQ = x, KE = r.

Prove RQ = r.

$$AQ\cdot QB = \overline{AP}^2 = \overline{AR}^2$$

or $2y(y+x) = (y+x+RQ)^2$.

Whence, $y^2-2yRQ = (x+RQ)^2$. (1)

Also, $OM\cdot OE = (OQ+RQ)^2$.

or, $y(y-2r) = (x+RQ)^2$. (2)

From (1) and (2), RQ = r.

(Note: By Norman Anning. If AB be produced to R′ making BR′ = BP, QR′ is the radius of a circle touching PQ, QB, and arc PB.)

Trigonometry.

409. *Proposed by N. P. Pandya, Sojitra, India.*

Two circles (centers P and Q) intersect one another orthogonally, and their radii are as 1:2. PQ cuts the minor arc of the smaller circle at

R. A direct common tangent touches the circles at H and K. HK is produced to L, so that HL = 2HK. In the circumcircle of HLQ a chord LM = QR is placed, M being on the arc HQL. Show that HQ and HM are two of the decasectors of ∠PHK.

I. *Solution by Nelson L. Roray, Metuchen, N. J.*

Let the circles cut at S. Then PSQ is a right triangle.

Take HA parallel to PQ intersecting KQ at A.

$\Delta HKA = \Delta PSQ$. $\therefore$ HK = SQ = KQ. $\therefore$ HQL is a right triangle and HL is the diameter of the circle through H, Q, and L. Also Q is the mid-point of arc HQL. QR = $a(\sqrt{5}-1)$, that is, the side of a regular decagon inscribed in a circle whose radius = $2a$.

$\therefore$ HM and HQ are a pair of decasectors of ∠PHL.

II. *Solution by L. E. A. Ling, La Grange, Ill., and Norman Anning, Clayburn, B. C.*

$PQ = \sqrt{PA^2+AQ^2} = \sqrt{1+4} = \sqrt{5}$.

$LM = RQ = PQ-PR = \sqrt{5}-1$.

$\sin MHL = \frac{ML}{HL} = \frac{\sqrt{5}-1}{4} = \sin 18°$.

$\therefore$ ∠MHL = 18° = $\frac{2}{10}$ of ∠PHK.

$\therefore$ HM is a decasector of the right angle PHK.

Arc LMQ is a quadrant.

$\therefore$ HQ is a decasector of the right angle PHK.

From these two we can construct all nine decasectors.

410. *Proposed by W. H. Thompson, Seattle, Washington.*

A series of poles of equal height are erected at intervals of 60 feet along a straight road. From a certain point the angles of elevation of the first, second, and fifth poles are 20, 37, and 10 degrees respectively. Find the height of the poles and the distance of the observer from the road.

I. *Solution by Walter C. Eells, Annapolis, Md.*

Let x = height of poles; a, b, c = distances of the observer from the feet of first, second, and fifth poles, respectively; d = distance of observer from the line of poles; α and α' = the supplementary angles made by b and the line of poles.

Then, $\frac{x}{a} = \tan 20°$, $\frac{x}{b} = \tan 37°$, $\frac{x}{c} = \tan 10°$. (1)

By the cosine law,

$\cos\alpha = \frac{a^2-b^2-3600}{120b}$ (2). $\cos\alpha' = \frac{c^2-b^2-32400}{360b}$ (3)

But since $\cos\alpha = -\cos\alpha'$, we have from (2) and (3)

$$3a^2-4b^2+c^2-43200 = 0. \quad (4)$$

Substituting the values of a, b, c from (1) in (4) it reduces to

$$x^2 = \frac{43200}{47.764}, \text{ or } x = 30.074.$$

From (1), $a = 82.626$, $b = 39.910$, $c = 170.558$.

From the triangle whose sides are a, b, 60 we find $\alpha = 109° 57' 8''$.

But $d = b\sin(180°-\alpha) = b\sin\alpha = 37.515$.

II. *Solution by Norman Anning, Clayburn, B. C.*

Let A, B, C, D and E be the feet of the posts, P, the position of the observer and Q, the foot of the perpendicular from P on AB. Denote AQ by x, PQ by y and the height of the posts by h.

$$y^2+x^2 = AP^2 = h^2\cot^2 20^\circ. \quad (1)$$
$$y^2+(x-60)^2 = h^2\cot^2 37^\circ. \quad (2)$$
$$y^2+(x-240)^2 = h^2\cot^2 10^\circ. \quad (3)$$

Dividing (2)—(1) by (3)—(1),

$$\frac{30-x}{4(120-x)} = \frac{3600-120x}{57600-480x} = \frac{\cot^2 37^\circ-\cot^2 20^\circ}{\cot^2 10^\circ-\cot^2 20^\circ} = \frac{-5.7877}{24.6147}$$

$$\frac{30-x}{120-x} = \frac{-5.7877}{6.1537}$$

$$\frac{x-30}{90} = \frac{5.7877}{11.9414}$$

$$\frac{3x-90}{90} = \frac{17.3631}{11.9414}$$

$$\frac{x}{30} = \frac{29.3045}{11.9414}, \quad x = 73.62 \text{ feet.}$$

(1)—(2): $120x-3600 = h^2(5.7877)$, $h = 30.1$ feet.

(1) $x^2+y^2 = h^2\cot^2 20^\circ$.

$73.62^2+y^2 = h^2\times 7.5487$.

$= 904.40\times 7.5487$, $y = 37.5$ feet.

} Ans.

These results are correct to the nearest tenth of a foot and "check" the given data to within a few minutes of arc.

III. *Solution by Nelson L. Roray, Metuchen, N. J.*

General solution.

Let h = height of poles, P the point of observation, α, β, γ angles of elevation of 1st, pth, and nth poles, a, b and c corresponding distances from P to feet of poles, θ angle between a and b, Φ angle between b and c, d distance between two consecutive poles and R distance from P to road.

Then $$\frac{ab\sin\theta}{cb\sin\Phi} = \frac{p-1}{n-p} \text{ or } \frac{\sin\theta}{\sin\Phi} = \frac{c}{a}\cdot\frac{p-1}{n-p}$$

and $$\frac{ac\sin(\Phi+\theta)}{ab\sin\theta} = \frac{n-1}{p-1} \text{ or } \frac{\sin(\Phi+\theta)}{\sin\theta} = \frac{b}{c}\cdot\frac{n-1}{p-1}$$

$$\frac{\sin(\Phi+\theta)}{\sin\theta} = \frac{\sin\Phi}{\sin\theta}\cdot\cos\theta+\cos\Phi\cdot\frac{\sin\theta}{\sin\theta} = \frac{b}{c}\cdot\frac{n-1}{p-1}$$

$$\therefore \quad \frac{n-p}{p-1}\cdot\frac{a^2+b^2-(p-1)^2d^2}{2b} + \frac{b^2+c^2-(n-p)^2d^2}{2b} = \frac{n-1}{p-1}\cdot b.$$

Whence $(n-p)a^2-(n-1)b^2+(p-1)c^2 = (n-p)(p-1)(n-1)d^2$. (1)

But $a = h\cot\alpha$, $b = h\cot\beta$ and $c = h\cot\gamma$.

Substituting these values in (1) we get

$$h = \frac{d\sqrt{(n-p)(p-1)(n-1)}}{\sqrt{(n-p)\cot^2\alpha-(n-1)\cot^2\beta+(p-1)\cot^2\gamma}}$$

R is altitude of triangle whose sides are a and b and base $(p-1)d$. $\therefore$ $R = \frac{2}{(p-1)d}\sqrt{s(s-a)(s-b)[s-(p-1)d]}$ or find angle opposite b and then $R = a\sin\beta$.

NOTE: Equation (1) is an interesting result. If $n = 3$, $p = 2$, the value obtained by solving for b is the median of the triangle whose sides are a, c and $2d$. Equation (1) is the general solution of the problem of which the median is a particular case.

395. *Proposed by F. Eugene Seymour, Trenton, N. J.*

In Greenleaf's National Arithmetic are found the following directions for finding the area of a segment of a circle: Find the length of the chord (its distance from the centre is given). Take $\frac{2}{3}$ of its product by

the height of the segment and add it to the cube of the height of the segment divided by two times the length of the chord. Discuss the accuracy of this method.

Solution by Nelson L. Roray, Metuchen, N. J.

Let c be the chord of the segment, d its altitude, 2θ its central angle, and r the radius of the circle.

Then $r = \frac{c^2+4d^2}{8d}$ and $\sin\theta = \frac{4cd}{c^2+4d^2}$.

Area segment = area sector − area triangle

$$= \theta r^2 - \frac{c}{2}\cdot\frac{c^2-4d^2}{8d} = \frac{(c^2+4d^2)^2}{64d^2}\sin^{-1}\frac{4cd}{c^2+4d^2} - \frac{c(c^2-4d^2)}{16d^2}$$

$$= \frac{c^2+4d^2}{64d^2}\left[\frac{4cd}{c^2+4d^2} + \frac{1}{2\cdot 3}\left(\frac{4cd}{c^2+4d^2}\right)^3 + \frac{1\cdot 3}{2\cdot 4\cdot 5}\left(\frac{4cd}{c^2+4d^2}\right)^5 + \cdots\right] - \frac{c(c^2-4d^2)}{16d}$$

$$= \frac{c(c^2+4d^2)}{16d} + \frac{1}{6}\cdot\frac{c^3d}{c^2+4d^2} + \frac{6}{5}\cdot\frac{c^3d^3}{(c^2+4d^2)^3} + \frac{(c^2+4d^2)^2}{64d^5}\left[\frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6\cdot 7}\left(\frac{4cd}{c^2+4d^2}\right)^7 + \cdots\right] - \frac{c(c^2-4d^2)}{16d}$$

$$= \frac{2}{3}cd + \frac{8}{15}\cdot\frac{d^3}{c} - \frac{16d^5}{c(c^2+4d^2)}\cdot\frac{11c^4+34c^2d^2+32d^4}{15(c^2+4d^2)^2} + \frac{(c^2+4d^2)^2}{64d^5}\left[\frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6\cdot 7}\left(\frac{4cd}{c^2+4d^2}\right)^7 + \cdots\right]$$

But $\frac{(c^2+4d^2)^2}{64d^5}\cdot\frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6\cdot 7}\left[\left(\frac{4cd}{c^2+4d^2}\right)^7 + \frac{7}{8\cdot 9}\left(\frac{4cd}{c^2+4d^2}\right)^9 + \cdots\right] <$

$$\frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6\cdot 7}\left[\left(\frac{4cd}{c^2+4d^2}\right)^7 + \left(\frac{4cd}{c^2+4d^2}\right)^9 + \cdots\right]\left(\frac{c^2+4d^2}{64d^5}\right)^2 < \frac{80}{7}\cdot\frac{c^5d^5}{(c^2+4d^2)^5(c^2-4d^2)^2}$$

Also $\frac{80}{7}\cdot\frac{c^5d^5}{(c^2+4d^2)^5(c^2-4d^2)^2} - \frac{16d^5}{c(c^2+4d^2)}\cdot\frac{11c^4+34c^2d^2+32d^4}{15(c^2+4d^2)^2} < 0.$

$\therefore$ $\left(\frac{c^2+4d^2}{64d^5}\right)^2\left[\frac{1\cdot 3\cdot 5}{2\cdot 4\cdot 6\cdot 7}\left(\frac{4cd}{c^2+4d^2}\right)^7 + \cdots\right] - \frac{16d^5}{c(c^2+4d^2)}\cdot\frac{11c^4+34c^2d^2+32d^4}{15(c^2+4d^2)} < 0.$

Hence the area of the segment $= \frac{2}{3}cd + \frac{d^3}{2c} + \frac{d^5}{30c} - K.$

And the error in taking $\frac{2}{3}cd + \frac{d^3}{2c}$ as the area is less than $\frac{d^5}{30c}$.

CREDIT FOR SOLUTIONS.

395. Nelson L. Roray (2 solutions). (2)
401. N. P. Pandya, Yeh Chi-Sun. (2)
402. N. P. Pandya, Yeh Chi-Sun. (2)
403. William Fenerwerger, George M. Link (Mechanical solution), N. P. Pandya. (3)
405. N. P. Pandya. (1)
406. Norman Anning. (1)
407. George M. Allen, Norman Anning, Niel Beardsley, T. M. Blakslee, John E. Campbell, W. Clark Doolittle, Walter C. Eells, R. T. McGregor, Claude O. Pauley, Nelson L. Roray, Elmer Schuyler, James H. Weaver (one incorrect solution). (13)

408. Norman Anning, L. E. A. Ling, Nelson L. Roray, J. R. Sage, Elmer Schuyler, James H. Weaver. (6)

409. Norman Anning, L. E. A. Ling, A. MacNeish, Nelson L. Roray. (4)

410. Norman Anning, Niel Beardsley, T. M. Blakslee, Walter C. Eells, Nelson L. Roray. (5)

Total number of solutions, 39.

PROBLEMS FOR SOLUTION.

Algebra.

421. *Proposed by Norman Anning, Clayburn, B. C.*

A carpenter's rough rule for octagon miter is: "Twenty-four and ten, cut on the ten."

(a) What other pair of integers on the steel square (barring 12 and 5) give as good an approximation?

(b) What is the best pair of numbers on an ordinary steel square graduated to eighths of an inch?

Geometry.

422. *Proposed by Henry B. Sanders, New York, N. Y.*

ABC is a triangle, right-angled at C. Angle B is bisected by BD, which meets AC at D.

Prove that $2\overline{BC}^2 : \overline{BC}^2 - \overline{CD}^2 = CA : CD$.

423. *Proposed by Norman Anning, Clayburn, B. C.*

Lines through the vertices of a triangle ABC divide the opposite sides in the ratios $m:n$, $p:q$, $r:s$. If XYZ is the triangle they determine, show that

$$\frac{\Delta XYZ}{\Delta ABC} = \frac{(mpr-nqs)^2}{(mq+nq+nm)(ps+qs+rp)(rn+sn+mr)}.$$

424. *Proposed by Elmer Schuyler, Brooklyn, N. Y.*

Given the edge of a regular tetrahedron equal to a, to find the radius of the sphere that touches the six edges.

Trigonometry.

425. *Proposed by Orlo Stearns, Washington, D. C.*

If $\sin 2x = \sin^2 3x$ show that $x = 15°$.

(From Gore's Plane and Spherical Trigonometry.)

SCIENCE QUESTIONS.

By Franklin T. Jones,
University School, Cleveland, Ohio.

Readers of School Science and Mathematics *are invited to propose questions for solution—scientific or pedagogical—and to answer questions proposed by others or by themselves. Kindly address all communications to Franklin T. Jones, University School, Cleveland, Ohio.*

Questions and Problems for Solution.

172. *Proposed by Maxwell Sosin, Perth Amboy, N. J.*

What is the edge of a cube of marble (sp. gr. 2.7) that can yield just enough CO_2 to produce 2889 grams of Na_2CO_3 by the Solvay process?

173. *Proposed by W. L. Baughman, East Saint Louis, Ill.*

One arm of a balance is 9 in. long and the other 10 in. Show that, if one weighs the substance to be sold as often in one scale pan as in the other, he loses 5% on his transactions.

Answer questions numbered 174, 175, 176 *in the following list:*

Columbia University.

Entrance Examination in Physics September, 1914.

Answer any six questions in Group *A* and any two questions in Group *B*.

Group A.

1. (a) State clearly what you understand by the term inertia and give two illustrations.

174. (b) How much force is required to pull a sled weighing 200 pounds up a hill rising 1 foot in 5 feet along the incline, neglecting friction?

How much work is done in pulling the sled 200 feet along the incline?

175. A homogeneous beam of constant cross-section has a length of 20 feet and weighs 75 pounds. The beam is supported at the ends A and B. What will be the force on each support if a weight of 100 pounds is hung at 3 feet and a weight of 150 pounds at 8 feet from the end A?

3. (a) Why does a balloon rise?

176. (b) If one cubic meter of air weighs 1.3 kilograms, and one cubic meter of illuminating gas weighs 0.80 kilogram, what volume of illuminating gas will be needed to cause a balloon to rise, if the balloon weighs 100 kilograms when empty?

4. (a) Explain how sound is propagated.

(b) Can sound be propagated through solids and liquids? State reasons for answer.

(c) Could the sound of a violent explosion on the moon be heard on the earth if the intensity of the explosion were very great? Explain.

5. (a) What is meant by the expression "the coefficient of linear expansion of iron equals 0.000012"?

How much will a rod of iron 30 feet long expand on heating it from 0° C. to 125° C.?

(b) Define specific heat of a solid.

6. (a) Describe briefly the construction and operation of a camera. What is meant by focusing a camera? Is the image formed in a camera real or virtual?

(b) What is meant by the principal focus of a lens?

(c) How will the focal length of a glass lens change on immersing the lens in water?

7. (a) If the cross-section of an electrical conductor is doubled and its length increased three times, what will be the final as compared with the original resistance of the conductor?

(b) Describe a method for determining experimentally the direction of flow of an electric current.

Group B.

8. What is the purpose of the pendulum of a clock?
How does the time of vibration of a pendulum vary as the pendulum is carried up a mountain? Why?
If the pendulum of a clock is lengthened, will the clock lose or gain time? State reasons.
9. Give the construction of a thermos bottle and explain why a cold liquid remains cool for some hours in such a bottle.
What will happen if the bottle is filled with warm liquid?
10. (a) Explain meaning of the term index of refraction.
(b) Trace the path of a ray of (1) yellow sodium light, (2) white light through a glass prism.
(c) What is meant by a 10 candle-power light?
11. (a) Explain the construction and action of two common types of primary cells.
What is meant by the polarization of a cell and how may it be lessened?
(b) How does a storage cell differ in construction and action from a primary cell?
(c) What is the cause of the current in a dynamo?

Columbia University.

Entrance Examination in Shopwork September, 1914.

NOTE.—Time: One hour and a half. Candidates may select either *A* or *B* or *C*.

A. WOODWORK.

1. Why does wood warp and how can warping be prevented?
2. What makes the "figure" in quarter sawed oak?
3. Why do some boards have more knots than others?
4. What kind of joints are used in making doors? Make sketches.
5. How does a rip saw differ from a crosscut saw?
6. Describe the process of putting a smooth-plane in first class shape, including the sharpening and setting of the cutter.
7. How would you lay out a dovetail joint for a drawer front five inches deep?
8. Describe the turning of a napkin ring. Show design and dimensions by sketch.
9. Name the principal parts of a speed-lathe and give their use.
10. What precautions need to be taken in turning convex curves?

C. MACHINE SHOP.

1. Give the following figures—
(a) The angle at which to grind a lathe center.
(b) The clearance, back slope, and side slope angles at which to grind a lathe roughing tool.
2. (a) What taper per foot would you get on a piece of work two feet long, if the dead center of a lathe was set-off $\frac{3}{4}$"?
3. What gears would you use to cut 12 threads per inch on a job, with a 6" thread lead screw?
(a) Where would you put the largest gear?
(b) What should be the shape and angle of the tool if the thread is the U. S. Standard?
4. Explain how you would set a gear blank in a milling machine to cut the teeth.
5. Which side of a leather belt should run next to the pulley?
6. Make careful sketches giving the angles of a whitworth, a buttress, and Acme thread.

7. Explain the use of a shaper, and how it differs from a planer.
8. Explain the use of a gap lathe, wheel lathe and axle lathe.
9. What is a precision lathe?
10. There are 8 direct measuring tools: Rules, scales, try-square, micrometer calipers, micrometer caliper square, vernier, vernier calipers, bevel protractor. Explain the use of each and the kind of jobs on which you have used them.

B. FORGING.

1. Make a sketch of any blacksmith forge you have used, and explain how it receives its blast.
2. If you use a soft bituminous coal for fuel, what steps are used to prepare it for use?
3. Explain how wrought iron is made and how Bessemer steel is made.
4. Make a sketch of four kinds of welds, showing the scarfs required for each.
5. Explain the use of (a) Blacksmith hammer, (b) Flatter, (c) Chisel, and (d) Set-hammer.
6. Describe the process of forging and welding a flat ring whose dimensions are 3″ inside, 5″ outside, $\frac{1}{4}$″ thick.
7. Give the following figures:
(a) The temperature to which a piece of steel must be heated for hardening.
(b) The rate of penetration of carbon per hour in case hardening steel.
8. A twist drill was heated to the proper hardening heat and then immersed till cold all over. What is one way to draw the temper?
9. Explain the process of forging a pair of tongs, the tongs should be made to fit both flat and round iron.
10. Explain the differences between a drop hammer and a steam hammer.

Solutions and Answers.

159. *Also solved by L. E. Lunn, De Smet, S. D.*

163. *From a Harvard Examination Paper.*

If a photographic print can be made in 30 seconds when held 3 feet from a 32 candle-power lamp, how long will it take at a distance of 2 feet from a 16 candle-power lamp?

Solution by Hugh Bersie, Northwestern University.

Data:

Print made in 30 seconds 3 feet from 32 candle-power.
Print made in x seconds 2 feet from 16 candle-power.

Formulas:

Intensity of illumination varies inversely as square of distance.
Hence print will be made in 60 seconds 3 feet from 16 candle-power.
Or by (1) it will be made in 26.6 seconds ($\frac{4}{9}$ of 60) 2 feet from 16 candle-power.

Also solved by Stanley T. Baker, Freeport, N. Y. and A. Haven Smith, Riverside, Cal.

164. *From a College Board Examination.*

At what depth in a lake will a bubble of air have one-half the volume that it has on reaching the surface when the barometric height at the surface is 73 centimeters? (The density of mercury is 13.6.)

Solution by Stanley T. Baker, Freeport, N. Y.

By Boyle's Law, the volume is inversely proportional to the pressure. To have the volume one-half what it is at the surface, the pressure must be twice as great or the pressure due to the water must equal the atmospheric pressure.

$73 \times 13.6 = 992.8$ grams pressure at surface.

Pressure on unit surface = Height × Density.

Density of water = 1.

∴ Height (or depth) = 992.8 c. or 9.928 meters.

Also solved by A. Haven Smith.

165. *From a Board Examination.*

At what distance from a 40-candle-power mantle burner would a newspaper receive the same illumination as it would receive from an 8-candle-power incandescent lamp 2 feet distant from it?

Solution by A. Haven Smith, Riverside, Cal.

$$40 : 8 :: x^2 : (2)^2$$

$$8x^2 = 160$$

$$x^2 = 20$$

$$x = 4.47 \text{ feet.}$$

Also solved by S. T. Baker.

166. *From a Board Examination.*

An electric motor, found, by a brake test, to develop 2 horse-power, requires 8.25 amperes at an electromotive force of 220 volts. What is the efficiency of the motor, expressed in per cent?

Solution by Hugh Bersie, Evanston, Ill.

Data:

Power of electric motor (by brake test) = 2 horse-power.

Voltage = 220.

Amperes = 8.25.

Efficiency of motor in per cent = ?

Formulas:

Volts × amperes = Watts.

Horse-power = 746 watts.

2 horse-power = 1492 watts output of motor.

$220 \times 8.25 = 1815$ watts put in motor.

The output is $(1492 \div 18.15)$ or 82.2% of the power put in.

Note by Stanley T. Baker.

This is assuming that the brake test gives correct results. However power calculated by the brake test is generally too high.

Also solved by A. Haven Smith.

ARTICLES IN CURRENT PERIODICALS.

American Forestry for December; *Washington, D. C.; $2.00 per year, 20 cents a copy:* "The Switzerlands of America" (fourteen illustrations), Agnes C. Laut; "Foresters in the Great War" (nine illustrations), Samuel T. Dana; "National Forest Administration," Hon. David F. Houston; "Tahiti" (eleven illustrations), E. T. Allen; "The European War and the Lumber Trade," R. C. Bryant; "Tackling Tamalpais" (five illustrations), Frederick E. Olmstead.

American Journal of Botany for November; *Brooklyn Botanic Garden, Brooklyn, N. Y.; $4.00 per year, 50 cents a copy:* "Investigations on the Phylogeny of the Angiosperms. 3. Nodal Anatomy and the Morphology of Stipules," Edmund W. Sinnott and Irving W. Bailey; "Observations on the Development and Germination of the Seed in Certain Polygonaceae," Edward F. Woodcock; "Some Ecological Adaptations of Certain Fern Prothallia—Camptosorus Rhizophyllus Link., Asplenium Platyneuron Oakes," F. L. Pickett.

American Naturalist for December; *Garrison, N. Y.; $4.00 per year, 40 cents a copy:* "The Failure of Ether to Produce Mutations in Drosophila," Prof. T. H. Morgan; "The Analysis of a Case of Continuous Variation in Drosophila by a Study of its Linkage Relations," Prof. John S. Dexter; "Shorter Articles and Correspondence: On the Progressive Increase of Homozygous Brother-Sister Matings," H. D. Fish.

Condor for November-December; *Hollywood, California; $1.50 per year, 30 cents a copy:* "A Forty-five Year History of the Snowy Heron in Utah" (with map and one photo by G. R. Walker), Antwonet, Edward and A. O. Treganza; "The Effects of Irrigation on Bird Life in the Yakima Valley, Washington," Clarence Hamilton Kennedy; "Breeding of the Bronzed Cowbird in Arizona" (with two photos by H. T. Murphy). M. French Gilman.

Educational Psychology for December; *Warwick and York, Baltimore, Md.; $2.50 per year, 30 cents a copy:* "The Generalizing Ability of Children," Harvey A. Peterson; "School Measurement," Ernest C. Witham; "Comparab'e Measures," Truman L. Kelley.

Journal of Geography for December; *Madison, Wis.; $1.00 per year, 15 cents a copy:* "War and the Food Supply in Europe," V. C. Finch, with 5 maps by the author; "The Geographical Conditions of National Defense," Joseph Partsch; "Unfamiliar Names in the Geography of Europe," "The Russian Campaign in Germany and Austria," Lawrence Martin.

Journal of Home Economics for December; *Roland Park Branch, Baltimore, Md.; $2.00 per year, 50 cents a copy:* "Fundamental Conceptions of Home Economics," Sarah Louise Arnold; "Current Problems in Home Economics," David Snedden; "School Lunches," Mary E. L. Small, Margaret McMillan and Ira S. Wile; "Housework, English and Immigrants," Emily Greene Balch; "Kanahoah, The House of Friends," Mabel Ward; "What Federal Meat Inspection Has Done for the Country," B. T. Galloway; "The Influence of Glucose on the Cooking Temperatures of Candy Syrups," Amy Daniels and Martha Troxell; "Score Cards," Inga M. K. Allison; "Food Values of Diets in British Workhouses," Mary G. McCormick.

Nature-Study Review for December; *Ithaca, N. Y.; $1.00 per year, 15 cents a copy:* "Editorial, the Nature-Study Course," C. F. Hodge; "The Nature-Study Course of the School of Observation and Practice, Philadelphia Normal School for Girls," Furnished by Adeline F. Schively; "The Nature-Study Course of the Elementary School, the School of Education, the University of Chicago," Furnished by Otis W. Caldwell; "The Oregon Course of Study in Nature-Study," Furnished by J. A. Churchill.

Popular Science Monthly for December; *Garrison, N. Y.; $3.00 per year, 30 cents a copy:* "The Cinchona Botanical Station," Duncan S. Johnson; "Ductless Glands, Internal Secretions and Harmonic Equilibrium," Fielding H. Garrison; "A New Phase of an Old Conflict," Launcelot W. Andrews; "The Normal Child, Its Physical Growth and Mental Development," Bird T. Baldwin; "Common Factors in Mental Health and Illness," F. Lyman Wells; "German Militarism and its Influence Upon the Industries," Hugo Schweitzer; "The War and the Weather During the First Three Months of the War," Robert DeC. Ward.

Physical Review for December; *Ithaca, N. Y.; $6.00 per year, 50 cents a copy:* "A Contrast Equality Photometer," A. H. Pfund; "The Hall Effect and Allied Phenomena in Silicon," O. E. Buckley; "Experiments on the Production and Measurement of High Vacua," J. W. Woodrow; "A Comparison of the Longitudinal and Transverse Joule Magnetostrictive Effects in the Same Specimens of Steel and Nickel," S. R. Williams; "Wave-Length-Sensibility Curves of Certain Crystals of Metallic Selenium; and a Partial Explanation of the Complexity of Light-Action in Selenium Cells," L. P. Sieg and F. C. Brown; "On the Silvering of Quartz Fibers by the Cathode Spray," Horatio B. Williams; "Note on the Direct Determination of h," O. W. Richardson; "Tem-

perature Distribution in an Incandescent Lamp Filament in the Neighborhood of a Cooling Junction," A. G. Worthing; "The Thermal Conductivities of Tungsten, Tantalum and Carbon at Incandescent Temperatures by an Optical Pyrometer Method," A. G. Worthing.

School Review for December; *University of Chicago Press; $1.50 per year, 20 cents a copy:* "Formalism in Defining High-School Units," Charles H. Judd; "High-School Students' Descriptions of Their Methods of Study," G. E. Rickard.

School World for December; *Macmillan and Company, London, Eng.; 7s. 6d. per year, 6 pence a copy:* "Education and Sex Aptitudes" (with diagrams), James Oliphant; "Education at the Australian Meeting of the British Association in Quest of Reality," E. Creagh Kittson; "Elementary Aspects of Plant Ecology," E. Stenhouse, Illustrated; "Reading in War Time," Dr. M. E. Sadler; "Science in the School Curriculum," A. T. Simmons.

Unterrichtsblätter für Mathematik und Naturwissenschaften, Nr. 7; *Otto Salle, Elssholzstr. 15, Berlin W. 57, Germany; M. 4 per year, 60 Pf. per copy:* "Die mathematische Statistik auf der Schule," H. E. Timerding; "Koordinaten im Gelände," Prof. Dr. M. Näbauer; "Die Behandlung der Pflanzenkrankheiten im Unterricht und ihre sozialhygienische Bedeutung," Dr. von Alten; "Zur Lehre von den Harmonikalen," Prof. Jos. Moser.

THE NEW JERSEY TEACHERS ASSOCIATION.

The winter meeting of this association was held Saturday, December 5th, at the Stevens Institute of Technology, at Hoboken. This was one of the most interesting and profitable meetings that the association has ever held. The attendance was good, there being present over one hundred members.

The morning session was called to order by the president, Mr. Frank F. Thomson of Rutgers College, who introduced President Humphreys of Stevens Institute, who gave a most excellent and interesting address on "Foundations First."

Mr. Jacob G. Lipman, director of the State Agriculture Experimental Station, spoke convincingly and interestingly on what is being done for the agriculture education in New Jersy. This was followed by a discussion of the topic.

The third address of morning session was on old and new methods of teaching chemistry in the high school by Oliver C. Short. This was followed by an interesting discussion led by Doctor Alexander Smith, of Columbia University.

After some miscellaneous business, the meeting adjourned for luncheon served by the Stevens Institute in the Stevens Castle, and after luncheon, the association divided itself into four sections, Biology, Chemistry, General Science, Agriculture and Physics.

In all of these sections, interesting, helpful, and profitable papers were read. Members present, took active part in the discussions.

These meetings are not so much for the information that one gets from listening to set papers, as it is for the benefit that one derives by brushing up to, and exchanging views with the person who is engaged in the same line of work as one's self.

If some of those instructors who do not now make it a business of attending meetings of this character, could only be made to see the value of the association's work, the efficiency of their teaching would be wonderfully increased. C. H. S.

REPORT OF SECTION MEETINGS OF THE NOVEMBER,[1] 1914, MEETING OF THE CENTRAL ASSOCIATION OF SCIENCE AND MATHEMATICS TEACHERS.

Minutes of Agricultural Section.

Meeting called to order by Prof. A. W. Nolan, Chairman, at 2:45 p. m., November 27, 1914, in Room 215, Hyde Park High School.

After a brief résumé of recent meetings held in the interest of Agricultural Education in the United States the chairman appointed the following nominating committee:

B. M. Davis, Oxford, Ohio.

Carl Colvin, Carlinville, Ill.

F. W. Plapp, Chicago, Ill.

Mr. A. McVittie of Bay City, Mich., and Mr. T. Sexauer of Menomonie, Wis., each assigned a paper on the program of the section, were absent, and their papers were not presented.

Supt. E. J. Tobin, of Cook County Schools, gave an address on "Redirected Rural Education." An interesting general discussion followed this address. Dr. B. M. Davis, of Miami University, Oxford, Ohio, read a paper on "The Amount and Place of Agriculture in a Unified Science Course in the Ordinary Accredited High School."

Mr. Carl Colvin, of Blackburn College, Carlinville, Ill., read a paper, and illustrated it with lantern slides, on the "Use of Land in Secondary Agriculture."

Mr. E. B. Collett, of DeKalb, Ill., high school read a paper on "The Fighting Chance of Agriculture."

The general discussion which followed the reading of these papers was spirited and full of valuable contributions to the problems of agricultural teaching.

The second session of the Agricultural Section was held Saturday morning, November 28th. Prof. B. M. Davis presided in the absence of the chairman. The nominating committee reported as follows:

President—A. W. Nolan, Urbana, Ill.

Vice President—Mrs. Genevieve Monsch, Gary, Ind.

Secretary—Lester Ivins, Columbus, Ohio.

The report was adopted and the above officers elected for the year 1915.

Prof. W. H. Smith of the College of Agriculture, University of Illinois, read a paper, "The Teaching of Animal Husbandry in Secondary Schools."

After a general discussion of this and other topics, the meeting adjourned.

HARRY L. BAUER, Sec.

Minutes of Biology Section.

The Biology section, with about sixty in attendance, was called to order by the Chairman, Mr. Harold B. Shinn, of the Carl Shurz High School of Chicago.

First in order was the appointment by the chair of the nominating committee, consisting of Mr. A. H. Conrad of Crane High School, Chicago; Miss Etta M. Bardwell of Cedar Rapids, Iowa, and Mr. E. S. Tillman of Hammond, Ind.

A very able and interesting paper on "The Present Status of Botanical Teaching in the Normal Schools" was given by Prof. Fred T. Ullrich of the Platteville Normal School, Platteville, Wis.

"The Present Status of Zoölogical Teaching" was discussed by Dr. Elliott R. Downing, of the School of Education, University of Chicago.

[1] For the General and Earth Science Section Minutes see the January issue of this Journal.

Dr. Downing talked of the position of zoölogy in the high school curriculum and of the methods and aims of zoölogical teaching.

A stimulating paper, "Problems in Teaching Practical Biology," was given by Miss Nettie M. Cook, of Springfield, Ill. She showed how the pupils made practical application of zoölogy in the home and the community.

As Mr. Frederick C. Lucas, of the Englewood High School, was unable to be present, his paper on "Practical Zoölogy" was read by the secretary. Mr. Lucas showed the necessity of adapting the work to the need of the pupil.

The discussion was opened by Mr. Shinn, who explained how, through the topics of heredity and variation, he leads up to the subject of sex teaching.

Mr. Louis E. Hildebrand, of the New Trier High School of Wilmette, Ill., presented a very successful method of handling the difficult subject of sex hygiene in connection with the regular work of zoölogy.

Miss Grace Ellis, of Grand Rapids, Mich., spoke of the aid that should be given the young student in selecting his high school course.

Miss Mabel E. Smallwood of the Lane Technical High School, Chicago, regretted that pupils in college so often duplicate the work of the high school. She wished that we might do something to prevent this. Moved and carried that the chairman appoint a committee to consider subject of duplication of work of high school and college. Mr. Shinn appointed Miss Smallwood, Mr. Conrad and Mr. Hildebrand on such committee.

Miss Ada L. Weckel of Oak Park, Ill., spoke of the helpful association of parents and teachers and of the exhibits of school work made at such meetings.

Mr. Louis E. Hildebrand of New Trier High School, Wilmette, Ill., described the practical work done in gardening and spraying of trees, all of which arouses great interest in the community.

Mr. J. R. Locke of Detroit, Mich., in reply to a question of the problem of half year science courses, suggested the plan he has tried successfully of a year of botany and a year of zoölogy in alternate years.

Before adjournment Mr. C. L. Holtzman of the Waller High School, Chicago, exhibited his display frames made of basswood strips, bought from bee keeper's supplies. These showed how easily and perfectly birds, skeletons, insects, leaves and seeds might be mounted.

SATURDAY, NOVEMBER 28TH, A. M.

The report of the committee on duplication of work was given by Mr. Conrad who recommended that this question of duplication be a number on next year's program and that the committee be continued to find out what are the requirements of the colleges.

Moved and carried that the report be accepted and that the committee be continued.

Mr. Conrad, chairman of nominating committee, reports as follows:

Chairman, Mr. Fred T. Ullrich, Platteville, Wis.

Vice Chairman, Mr. W. A. Pierson, LaFayette, Ind.

Secretary, Miss Nettie M. Cook, Springfield, Ill.

Moved and carried that the secretary cast the white ballot for persons nominated.

The rest of the morning was spent in looking at the splendid collection of exhibits brought together. Lantern slides of flowers, birds and insects made and exhibited by Ralph E. Wager of DeKalb, Ill., and the slides of flowers and trees, made by Worralo Whitney, of the Hyde Park High School, were much appreciated.

Mr. A. H. Conrad of the Conrad Slide and Projection Co., showed a valuable collection of slides to illustrate the economic importance of birds.

Mr. Shinn demonstrated the use of some of his microscopic mounts with the lantern.

Mr. Small, of Bausch and Lomb, showed the advantages of the new binocular microscope.

Mrs. Margaret C. Young, of Hyde Park High School, showed her collection of living animals in the laboratory and spoke of her colony of bees on top of the building.

Miss Cook's charts displayed the work of her pupils in their efforts to exterminate the fly.

Moved and carried to accept Mr. Shinn's offer to make a list of places where teachers might obtain various kinds of exhibits. This list he will send to any teacher upon receipt of stamped envelope.

CHARLOTTE H. STETSON, *Sec.*

Minutes of Chemistry Section.

The chemistry section of the Science and Mathematics Teachers Association held its first session in Room 312, Hyde Park High School, Chicago, November 27, 1914. Mr. H. M. Ibison, chairman of the section, presided. In the absence of the secretary, H. D. Abells, S. G. Engle, Gary, Indiana, was elected to fill the office pro tem.

Miss Ruth Johnston, Milwaukee-Downer College, Milwaukee, Wis., presented a paper on "High School Preparation for College Work in Science." In the paper, Miss Johnston claimed that the demands which the colleges could put upon the students did not seem worthy of the student nor the subject taught. This she thought was due to lack of preparation for the college work, or that the college requirement was too high. Miss Johnston suggested that the high school sciences be limited to a fewer number, rather than dissipated over the whole field; that the work be made a problem rather than an entertaining subject; that the teacher be an expert and an enthusiast with a vision, and that the classics be granted a larger place in the high school curriculum.

In the discussion, Mr. Wirick claimed that it was not at all the business of the high school to prepare the student to enter college, and it was a mistake to have in view the preparing for that end. The purpose of the school was to "teach the boys and girls." Mr. Norris in this connection spoke on school administration and the relation of the high school to the college. He thought there should be a better understanding between the two institutions. Mr. Roecker said that the reason for a lack of understanding was not altogether the fault of the colleges and universities—that they were ready and willing to meet the high school half way at any time. Mr. Radcliff said that it was, in his estimation, the duty of the high school to prepare the student for college and more, it was "to teach him to think."

The second paper was by G. C. Ashman, Bradley Polytechnic Institute, Peoria, Ill., on "What Chemistry Should a Girl Have, Who Expects to Become a Teacher of Domestic Science?" Mr. Ashman said it had been his experience that the average domestic science teacher made very little use of her knowledge of chemistry and in reality merely taught "cooking." He thought since so little direct use was made, that we should be careful as to time taken to teach these students also as to the subject matter taught.

In the discussion of this paper there was a large variety of opinions expressed, both as to whether or not the domestic science teacher uses

the chemistry and as to just what should be included in such a course. The papers by M. A. Wadleigh, East Division High School, Milwaukee, Wis., on "Vital Chemistry; Phases of Teaching it" and by E. A. Strong, State Normal College, Ypsilanti, Mich., were not discussed, because of the lateness of the hour.

Moved by Mr. Powers, seconded by Mr. Roecker that the Home Economics and Chemistry Sections meet in joint session next year. Carried. The chairman then appointed the following committees:

Nominating: J. C. Hessler, Miss Jessie Caplin, and C. M. Wirick.

Resolutions: W. F. Roecker, S. R. Powers and H. H. Radcliff.

Mr. Norris spoke of organizing a round table by correspondence. He called for all present, who were willing to answer letters on live chemistry to sign their names to a paper so the secretary could get the list. The following names were handed in to the secretary: C. M. Wirick, Crane Tech. H. S., Chicago; W. S. Whitman, 100 Washington Sq., New York, N. Y.; R. M. Roberts, La Grange, Ill.; R. E. Davis, 6118 Kenwood Ave., Chicago; Ray McClellen, Michigan City, Ind.; Albert L. Smith, Englewood High School, Chicago; M. I. Meyer, Crane Tech. H. S., Chicago; Jessie F. Caplin, West High School, Minneapolis, Minn.; Leslie W. Lyon, High School, Burlington, Iowa; J. P. Young, Huntington, Ind.; Raymond W. Osborne, 330 Webster Ave., Chicago; S. R. Powers, Garfield H. S., Terre Haute, Indiana; W. F. Roecker, Wisconsin H. S. of University of Wis., Madison, Wis.; M. F. Wadleigh, Milwaukee, Wis., S. D. High School; R. F. Ratcliff, Central Normal College, Danville, Indiana; S. G. Engle, Director of Sciences, Gary Public Schools, Gary Indiana.

The Chemistry section held its closing session Saturday morning in Room 119, Hyde Park High School. Mr. C. M. Wirick, Crane High School, Chicago, gave "A Critical Analysis of the Merits of Recent Text-Books in Chemistry." He used eight texts as the basis of his remarks. He found that of these eight texts only three of them had been directly or indirectly written by high school teachers. He said that the merit of the different books was doubtful, but they were the most widely used, and were probably as good as we had. The different authors were not at all agreed as to the order in which the subjects should come, nor agreed upon the relative importance of the different topics. He found the Periodic Law printed very differently in the different books, and no two agreed as to the time in the Course for its presentation. In some cases, Mr. Wirick found the English to be very poor.

Owing to the late start, there was not time for any discussion. The secretary read a letter from the Secretary of the H. E. Section, accepting the invitation for a joint session next year with the Chemistry Section.

The Committees gave the following reports:

Nominating: For Chairman, L. B. Altaffer, Cleveland, Ohio; for Vice Chairman, S. G. Engle, Gary, Indiana; for Secretary, Miss Emma J. Fordyce, Cedar Rapids, Iowa. Report accepted.

Mr. H. R. Smith, chairman of the committee, read the report of the committee on Practical Chemistry. Report accepted and the committee continued in its good work.

Meeting closed in form. Present—31.

S. G. ENGLE, *Secretary pro tem.*

Minutes of Mathematics Section.

The Mathematics Section of the Central Association of Science and Mathematics Teachers held two meetings—Friday and Saturday, November 27 and 28, 1914, at Hyde Park High School, Chicago, at which H. L. Terry, the chairman, presided.

FRIDAY AFTERNOON SESSION.

The first number on the Friday afternoon program was a paper on "The Elements of a Successful Recitation," by Richard E. Krug, Principal of North Side High School of Milwaukee. Mr. Krug urged that high school inspectors investigate conditions and find out to what extent the teacher is responsible for poor results, before they pass judgment on a recitation. Merely hearing reproductions from memory or testing does not constitute a recitation.

Four requisites of successful teaching are:

1. Force, due to the personality of the teacher.
2. Clearness, due to his learning or culture.
3. Unity, due to his art or craftsmanship.
4. Beauty or elegance, due very largely to the character and extent of the experience of the teacher.

In enlarging upon and explaining these requisites, Mr. King gave some very practical and helpful suggestions.

This paper was followed by "Observations of the Teaching of Mathematics," by John Calvin Hanna, State High School Inspector, of Springfield, Illinois. He said that of the three parts of a recitation, examination, drill, and instruction, it is the third one that is usually neglected. Instruction "is a big word and has in it the idea of building—building mind, building soul, building life, building character." He showed the advantages of real class recitations and decried the prevalence of the dialogue method; and urged that devotion to the teaching of youth be above the devotion to our specialty.

In the discussion which followed the importance of the "question" was emphasized, and the reading of Dr. Romiet Stevens' book, "The Question as a Measure of Efficiency in Instruction," was recommended.

The last paper for the session was "The Training of Teachers of Mathematics," by G. A. Miller, Professor of Mathematics, University of Illinois. He set a very high standard as a minimum requirement in theoretical mathematics. Some distinction was made between the training of the teacher and the education of the teacher.

This paper provoked many suggestions; as training teachers by letting them teach under direction; the granting of sabbatical years to secondary teachers was urged; universities should offer a good course in plane geometry.

The chairman appointed the following nominating committee:

Mr. H. E. Cobb, Chairman, Lewis Institute, Chicago.

Miss Elizabeth McConnell, University High School, Madison, Wisconsin.

Mr. Chas. Ammerman, St. Louis, Missouri.

About 120 were present at the Friday afternoon session.

SATURDAY MORNING SESSION.

At the Saturday morning session Mr. W. W. Hart, of the University of Wisconsin, presented each one in attendance with a Report on the Teaching of Mathematics in Germany, as submitted to the International Commission, which he discussed and explained. Appended to the report is a detailed course in Mathematics as given in the Oberrealschule in Kiel.

The nominating committee submitted the following report:

For Chairman, Miss Edith Long, Lincoln High School, Lincoln, Nebraska.

For Vice-Chairman, Dr. J. W. A. Young, University of Chicago.

For Secretary, Miss Marie Gugle, Supervisor of High Schools, Columbus, Ohio.

The report was accepted and the chairman of the committee was instructed to cast the ballot for the persons nominated.

The treasurer's report was read and approved, and a collection taken.

Mr. K. G. Smith, of Ames, Iowa, as chairman of the committee, presented the Report on Vocational Mathematics. The following conclusions were drawn:

1. Specialized courses for different trades are being given at the present time in special schools or special courses.
2. Mathematics courses specialized in the trades are not given in academic high schools.
3. Specialization in public school classes for those who have not chosen their life work is neither necessary nor desirable.
4. Specialization is necessary and desirable for those who have chosen their life work and are in attendance at trade, continuation, or evening schools.

The report was accepted and the committee continued.

Professor Meyers withdrew from the committee. On a motion by Mr. Hart, the committee was empowered to add to its membership from the Home Economics Department.

In the round table discussion many topics of vital interest were introduced.

The following Publicity Committee was appointed to spread reports of this and other associations, also the latest literature and texts.

Miss Adkins of Normal University.

Mr. W. W. Hart of University of Wisconsin.

Miss Ethel Jaynes of Lane Technical High Schoo', Chicago.

On a motion by Miss Woodyard of Kansas City, four former committees were revived, in order that the old reports may be brought up to date. These are:

Committee on Geometry.

Committee on Algebra.

Committee on Unified Mathematics.

Committee on Applied Problems.

All members of the former committees are requested to act on these.

Mr. Comstock reported that the Committee on Results is still at work and would be ready to report later.

Ninety were present at the Saturday morning session. The section adjourned at noon.

MARIE GUGLE, *Secretary.*

Minutes of Physics Section.

The chairman, Mr. Frank E. Goodell, called the meeting to order at 1:55 p. m., in the physics lecture room of the Hyde Park High School. About sixty members were present. The chairman then appointed as nominating committee Mr. H. Clyde Krenerick, Milwaukee, Wis., Mr. C. E. Linebarger, Chicago, and Mr. C. E. Spicer, Joliet, Ill.

The first paper of the afternoon, "New Methods of Treating Some Old Mechanical Problems," was given by Harvey N. Davis, Professor of Physics, Harvard University. Professor Davis made the "parallelogram of forces" the chief basis for the lecture, which was illustrated experimentally by an ingenious aluminum model of a bridge, and photographically by lantern slides of actual types of bridge construction which are to be found in great abundance on every highway or railway. The scheme for "isolating" a particular portion of the system of forces was shown in a most interesting and concrete manner.

The speaker explained in detail the reasons for the varieties of truss construction, and showed how all of these are merely the results of the action of forces brought into play by the members of the combination.

Two facts were set forth in a most striking manner,—first, the importance of the so called "triangle of forces" in the world of affairs, and, second, the effective, but unfortunately uncommon, plan of basing the teaching of physics upon the real phenomena of the local community, whether this be by making lantern-slides of the illustrations in question, or by means of an excursion to the points of interest. It was indicated that not everything given in the lecture could be taught in high schools, but we venture the suggestion that with the model aluminum bridge which was shown by the speaker, a surprising amount of the material given in the lecture could be taught to high school seniors if it were advisable, and the subject of the "application of forces" would become one of the most valuable and interesting of all physics.

Following this paper, Mr. Chas. H. Smith, Hyde Park High School, Chicago, described the arrangements for the Physics Section to visit the Grand Crossing Tack Company, where the members could have the opportunity to see the manufacture of tacks, brads, nails, wire-cloth, staples, screw-eyes, etc., etc., by automatic machines—almost human in their operations. About thirty members signified their intention of making the trip.

The second paper was an illustrated lecture concerning "Sound Waves" by Arthur L. Foley, Professor of Physics, Indiana State University. In a brief way, Professor Foley first described the *"Schlieren Method"* of photographing sound waves, which was used by Toepler, Mack and Wood, and pointed out the objections to this method, the chief perhaps being the high cost of a large corrected lens, and the small size of the pictures obtained. The "point source shadow method" was then described, as used by Professor Foley and first discussed by him before the American Physical Society in 1905. The speaker showed about thirty photographs of sound waves.

It is not enough to say "that with these slides it is unnecessary to continue longer to deal with the subject of wave motion in an abstract, conventional way. The student need no longer depend entirely upon diagrams and upon his imagination, for in these sound wave pictures he has *actual photographs* of sound waves in all stages of transmission, reflection, refraction and diffraction. The pictures completely verify Huygens' theory. Every picture shows in a beautiful way what is meant by 'centers of disturbance,' 'wavelets,' 'radius of curvature,' 'wave,' 'wave fronts,' 'common tangents,' 'wave envelopes,' 'diffraction,' 'reflection grating,' 'transmission grating,' 'Huygens' construction,' etc."

Professor Foley was accorded hearty congratulations by the members for his remarkable investigation.

"Some Practical Points in Making Lantern Slides," by Mr. C. S. Coons, Froebel School, Gary, Indiana, was the last paper of the afternoon. Mr. Coons recommended that every school make its own lantern-slides because:

1. It is economical.
2. The processes have educational and scientific value.
3. It is more convenient than the purchase of lantern slides.
4. Teachers and students are more interested in the slides made by themselves than in those purchased from a dealer.

The speaker pointed out that any step in the making of slides can be taught to pupils in a much shorter time than is usually conceded. The coloring of the slides can well be given to the art department, and the cataloging and distribution to the city or school library.

Following this paper the section held a symposium on new apparatus, and listened to representatives of:

(a) Central Scientific Company, Chicago, concerning:
1. The oscillograph tube as used with a rotating mirror to make visible the potential wave form of alternating currents.
2. Alternating current apparatus as designed for high schools by Mr. Elmer E. Burns.
3. Full set of lantern slides on "Photography of Sound Waves," as taken by Professor Arthur L. Foley.

(b) Weston Electrical Instrument Company, Newark, N. J., concerning:
1. A new model galvanometer with a convenient scale at 45 degrees. It was stated that a very considerable sum of money was spend in the researches to produce such a sensitive instrument at a low price.
2. A new double scale volt-ammeter for high schools.
3. A new type of watt-meter designed for wide range of use in high school work in D. C. and A. C. power measurements.

(c) McIntosh Stereopticon Company, Chicago, Ill., concerning:
1. Improved forms of lanterns for lecture and demonstration use.

SATURDAY MORNING SESSION.

The section was called to order at 10:30 a. m. by Mr. Frank E. Goodell. The nominating committee gave a report as follows: Chairman, T. L. Harley, Hyde Park High School, Chicago; Vice chairman, H. E. Hammond, Central High School, Kalamazoo, Mich.; Secretary, Miss Isabell Johnson, Milwaukee-Downer College, Milwaukee, Wis.

A motion was made, seconded and unanimously passed to appoint a committee of three to express the sympathy of the members of the section to the family of Mr. Chas. F. Adams, whose death occured October 29, 1914. Mr. Adams was head of the department of physics of the Detroit Central High School, an author well known among scientists and educators, and a man whose work is highly appreciated by the Central Association of Science and Mathematics Teachers. Mr. Chas. M. Turton, Bowen High School, Chicago, was made chairman of the committee, and was empowered to select the two additional members.

The first lecture, "Adapting Instruction in Alternating Currents to High School Classes," was given by Mr. Elmer E. Burns, Joseph Medill High School, Chicago. By means of experiments and lantern slides, the speaker showed in a most effective manner that the subject of alternating currents can be taught in high schools without the use of advanced mathematics. The simplicity of the experiments and ingenuity of the apparatus designed by Mr. Burns were very favorably commended by the members of the section.

A simplified transformer set was shown, by means of which experiments concerning transformer tests, choke coils, the permeameter, Lenz' law and the auto-transformer were demonstrated.

A Gramme ring coil was also used to show the rotating field in an induction motor; the two and three phase voltage transformer and the phase transformer.

When consulted concerning the possibility of obtaining his lecture in definite form, Mr. Burns referred us to "Alternating Currents Simplified," as published by J. C. Branch Publishing Company, 608 S. Dearborn Street, Chicago.

Dean P. B. Woodworth, Lewis Institute, Chicago, briefly discussed the paper of Mr. E. E. Burns, in some of the important applications to the affairs of everyday life.

Later Mr. Woodworth discussed an investigation conducted by himself concerning the "sound insulating properties" of various building materials. The speaker showed a simple experiment of Kundt's and pointed out that no units were available for the quantities he wished to measure. Slides were shown of the apparatus tried and discarded in the process of the investigation. The speaker showed how a small building was constructed of various materials, and described an ingenious method of using telephone receivers to measure the apparent sound intensity on both sides of the wall, and how finally how the "apparent coefficient of sound transmission of a substance was expressed in *ohms*,"—"the joke of the whole investigation," as Mr. Woodworth expressed it. However the results secured were recently corroborated by an eastern investigator.

The section adjourned at 12:20 p. m. to attend the complimentary luncheon tendered to the Association by the faculty of the Hyde Park High School.

SPECIAL NOTICE TO PHYSICS TEACHERS.

Dr. W. A. Hedrick, McKinley Manual Training School, Washington, D. C., has undertaken to form all the information, blueprints, laboratory direction sheets, etc., recently issued by The Joint Committee on Physics into a United States Bulletin of the Department of Education. Additional contributions in the form of experiments or demonstration exercises will be gladly received by Dr. Hedrick or Mr. J. A. Randall, Pratt Institute, Brooklyn, N. Y. It is not necessary to add that this is an opportunity worth careful consideration. EARL R. GLENN, *Secretary*.

Minutes of Home Economics Section.

The Home Economics section of the Central Association of Science and Mathematics Teachers was called to order by Miss Minna Denton, chairman, at 1:30 p. m.

Registration cards and applications for membership were passed.

Mr. Willis E. Tower, president of the association, made a brief address, in which he said it was voted in the executive meeting of the association to make the Home Economics section a unit with other sections. It was the hope of the association that the new sections would raise the standard of the others and that each would be a benefit to the other. Mr. Tower explained that the membership dues were $2.50, which sum included the magazine, SCHOOL SCIENCE AND MATHEMATICS, and a copy of the proceedings and committee reports.

The meeting adjourned to the small gymnasium because of the unexpected size of the section.

The chairman announced the excursion to Marshall Fields Moving Picture Textile Show at 1:30 p. m., Saturday. Thirty-five people signified their intentions of going. The trip to Ward Baking Powder Company was cancelled because no one in the audience expressed a desire to go.

The chairman called attention to the exhibits of note books, recent textbooks, and illustrative material from commercial sources in Room 337, and to household appliances in the gymnasium. Announcement was made that tables would be reserved for the Home Economics section at the dinner Friday night. The program opened with the reading of five minute papers as follows:

1. Household Management, Miss Bernice Allen, University High School, University of Chicago.

2. Teaching Food Work through Preparation of Meals, Agnes Wilson, Housekeeping Center, Stock Yards District, Chicago.

3. House Decoration, Isabel Clark, Director of Household Arts, Beach Manual Training School, Oshkosh, Wis.

4. High School Dietetics, Ada Hillier, Supervisor of Household Arts, South Bend, Ind.

After the reading of this group of papers, Miss Marlatt, University of Wisconsin, raised the question, What Should a Course in Household Management Contain? According to her ideas, foods and dietetics were out of place in a course in Household Management; also architecture in House Decoration. Miss Marlatt, upon request, defined Household Management as a course which should deal with management of the home—a conservation of time and income. Economy of time was as essential as management of income. Miss Van Hosen, University of Chicago, proposed that a committee be appointed to investigate terms that are used in common in naming courses in Home Economics.

Miss Clark made a motion that a committee of five be appointed by the chairman to deal with the terminology of courses in the High School in Home Economics, the report to be made at the meeting in 1915. The motion was seconded and carried.

The chairman appointed the following committee:

Miss Gertrude Van Hosen, School of Education, University of Chicago; chairman.
Miss Isabel Clark, Beach Manual Training School, Oshkosh, Wis.
Miss Firth, Davenport, Iowa.
Miss Latta, Columbus, Ind.
Miss Anna Green, DeKalb, Ill.

The regular program continued.

5. The High School Lunch Room, Helen M. Sabin, Lucy Flower Technical High School, Chicago.

6. Discussion, Grace Hood, Director Domestic Science, Lewis Institute, Chicago.

7. Textile Testing for High School Girls, Julia Tear, Domestic Art Department, Hyde Park High School, Chicago.

8. Drafting of Dress Patterns, Agnes K. Hanna, School of Education, University of Chicago.

All papers were attended with great interest. Mrs. Sabin's talk on the Lunch Room course caused many questions to be asked in regard to the details of management.

The meeting adjourned at five o'clock.

SATURDAY, NOVEMBER 28TH.

The meeting was called to order at 10:25 by the chairman.

The report of the nominating committee, of which Miss Mildred Weigley was chairman, for officers for the ensuing year, was as follows:

Miss Agnes K. Hanna, University of Chicago; chairman.

Miss Emma Conley, State Inspector of Domestic Science, Wisconsin, vice chairman.

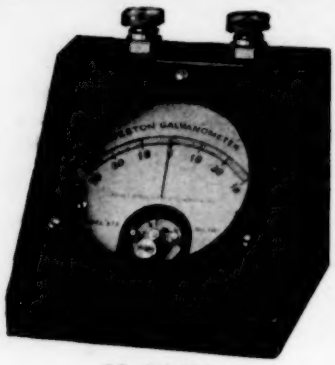
Miss Minna Denton, University of Ohio; secretary.

It was moved and seconded that the report be accepted. The motion was carried.

A communication from the Chemistry section was presented by the chairman inviting the Home Economics section to a joint meeting with the Chemistry section for a portion of one of the meetings, at the next meeting. It was moved and seconded that the invitation be accepted. The motion was carried.

Weston

STUDENT'S GALVANOMETER



has been designed especially for Science Instructors who require a Portable Galvanometer of great durability, reasonable sensitivity and moderate cost.

Resistance, 29 Ohms. Current required for 1 scale deflection (1 m.m.), 16 Micro-Amperes. With 1 volt, a deflection of 1 scale division will be obtained through 62,500 Ohms, but as one-tenth deflection can readily be detected, the Galvanometer is in reality serviceable through 312,500 and therefore is admirably adapted to High School Laboratory work. Write for discounts and circular.

Have you a full set of Weston Monographs, issued for Science Teachers?

Model 375

Scale length, 2.35 inches; Calibration, 30-0-30. List price, $9.00, F. O. B. Newark, N. J.

Weston Electrical Instrument Company, Newark, N. J.

New York	Boston	San Francisco	Buffalo	Toronto	Vancouver
Chicago	St. Louis	Detroit	Atlanta	Montreal	Berlin
Philadelphia	Denver	Cleveland	Richmond	Winnipeg	London

The regular program was carried out.

1. Attitude of the Home Towards School Home Economics, Mrs. W. S. Hefferan, Vice President and Chairman Parent-Teacher Committee of National Congress of Mothers, of the National Education Association. Chicago.

2. School, Credit for Home Work in Home Economics, Grace Schermerhorn, Director of Practice Teaching in Home Economics, Iowa State College, Ames, Iowa.

3. Discussion, Abby Marlatt, Head of Home Economics Department, University of Wisconsin.

4. Home Project Work in Southern High Schools, Louise Stanley, Chairman Home Economics, University of Missouri.

5. High School Food Work, What Besides Manipulation, Emma Conley, State Inspector of Domestic Science, Wisconsin.

The greater amount of freedom in discussion at this meeting was evidence of as much, if not more, interest than that in the preceding meeting.

The meeting adjourned at 12:15. BERNICE ALLEN, *Secretary.*

KANSAS ASSOCIATION OF MATHEMATICS TEACHERS.

The thirteenth regular meeting of the Kansas Association of Mathematics Teachers was held in Topeka, November 13, 1914.

Professor R. D. Carmichael of the University of Indiana gave an address on the subject "Mathematics and Life—The Vitalizing of Secondary Mathematics." The paper is published on page 105 of this Journal. He stressed the fact that efficiency is the one thing in life that counts. Secondary mathematics is to enter into definite relations to the life of the students. It is to be practical mathematics in part, but is not to be exclusively vocational mathematics.

Prof. W. T. Stratton of the Kansas State Agricultural College discussed Prof. Carmichael's address. See page 115 of this Journal.

The recent revision of

Millikan and Gale's First Course in Physics

has been so favorably received in schools throughout the country that a revision of the Laboratory Course by the same authors was made necessary. In this

First Course in Laboratory Physics

By **Robert Andrews Millikan, Henry Gordon Gale** and **Edwin Sherwood Bishop,** The University of Chicago.

substantial improvements in size and arrangement have been made, wherever improvement was possible. In about fifty experiments this laboratory manual furnishes a complete survey of the subject by means of direct, first-hand contact with the most significant physical principles and their applications to daily life. While adapted especially to meet the laboratory requirements of Millikan and Gale's First Course in Physics it can be used satisfactorily with any other text-book or independently of any classroom text. Available in cloth (50 cents) or loose-leaf binding (80 cents).

Ginn and Company: Publishers

BOSTON NEW YORK CHICAGO LONDON
ATLANTA DALLAS COLUMBUS SAN FRANCISCO

W. H. Grayum, Principal of the Neodesha High School, gave an interesting talk on "the Mathematics Course of Study in the Junior High School." Prin. Grayum told of his course as he is working it out in his high school. Supt. Hughes of Chanute discussed this address.

The following persons were named to serve on a committee to draft a course of study for the mathematics in a six year high school: Professor U. G. Mitchell, Chairman, University of Kansas; Miss Ella Woodyard, Kansas City, Kansas, High School; Miss Eleanora Harris, Hutchinson High School; Miss Effie Graham, Topeka High School; Professor W. H. Andrews, Kansas State Agricultural College; Superintendent C. A. Wagner, Junction City Schools; Miss Mary Kelly, Wichita High School.

The officers for the coming year are: President, Miss Lucy T. Dougherty, Kansas City, Kansas, High School; Vice-President, Supt. H. C. McMillan, Kingman; Secretary-Treasurer, Miss Eleanora Harris, Hutchinson High School.

BOOKS RECEIVED.

Evolution of Sex in Plants, by John M. Coulter, University of Chicago. Pages vii+140. 13x19 cm. Cloth. 1914. $1.00 net. (W) The University of Chicago Press.

Vocational and Moral Guidance, by Jesse B. Davis, Central High School, Grand Rapids. Pages viii+303. 13.5x19.5 cm. Cloth. 1914. $1.25. Ginn and Co., Boston.

School Discipline, by William C. Bagley, University of Illinois, Urbana. Pages xiv+259. 13.5x19 cm. Cloth. 1914. $1.25 net. The Macmillan Company, New York.

Naturalists Directory, by Samuel E. Cassino, Salem, Mass. 199 pages. 13x19 cm. Cloth. 1914. $2.50. Samuel E. Cassino, Salem, Mass.

How to Teach American History, by John W. Wayland, Normal School, Harrisonburg, Va. Pages x+349. 13x19 cm. Cloth. 1914. $1.10. The Macmillan Company, New York.

English Composition for College Women, by Elizabeth Moore, Dora G. Tompkins and Mildred MacLean, Iowa State College. Pages xi+314. 13x19 cm. Cloth. 1914. $1.25 net. The Macmillan Company, New York.

Experiments, by Philip E. Edelman. Pages 256. 14x20 cm. Cloth. 1914. $1.50. Philip E. Edelman, Minneapolis, Minn.

Household Physics, by Alfred M. Butler, High School of Practical Arts, Boston. Pages viii+382. 13.5x19 cm. Cloth. 1914. $1.30 net. Whitcomb and Borrows, Boston.

The High School, by John E. Stout, Cornell College. Pages xxiii+322. 13.5x19 cm. Cloth. 1914. $1.50. D. C. Heath & Co., Boston.

BOOK REVIEWS.

Trigonometry, by Maxime Bocher, Professor of Mathematics in Harvard University, and Harry D. Gaylord, Mathematical Master in Browne and Nichols School, Cambridge. Pages ix+142. 13x19 cm. 1914. Henry Holt Co., New York.

This textbook for high schools and colleges, in which only the essentials with very brief explanations are given, will interest teachers who do not care for the full and informational treatment which characterizes most of the recent trigonometries. All the exercises are collected at the end of the book, filling forty-four pages. There are very few applications and practical problems. With proper care on the part of the instructor students will not find this concise and somewhat limited treatment of the subject dry and uninteresting. Huntington's four-place tables are recommended for use with this book. H. E. C.

Elements of General Science, by Otis W. Caldwell, University of Chicago, and William L. Eikenberry, University High School, University of Chicago. Pages xiv+308. 14x20 cm. Cloth. 1914. $1.00. Ginn and Company, Chicago.

The reviewer, while at the recent University of Illinois High School Conference at which discussions of the proposed general science course occupied a very important part of the time, heard several speakers assert that no good text of general science had as yet been written. Whether these speakers had seen the present book the reviewer, of course, has no means of knowing, but if they had seen it, their judgment of textbooks suitable for the course in general science would seem to be at fault.

There are several points favoring the success of this contribution by Professors Caldwell and Eikenberry to the list of general science textbooks. In the first place they are biologists by training and profession. We think the assertion can safely be made that biologists in general have a better understanding of physics and chemistry than physicists and chemists have of biology. Biologists must know these subjects if they are to be successful while biology on the other hand is not so necessary to the physicist or chemist. The biologist is thus better equipped to write a general science textbook than the physicists or chemists who have heretofore done most of the work in this line. In our opinion, moreover, the life problems in our environment form a better basis for the groundwork of a general science course than do the physical problems.

The book is the result of several years trial and experience in classes of high school pupils—a severe trying out of ideas and plans. This is

The 'Varsity
ELECTRIC OVEN

With Regulator
Price, $30.00 Net

Designed to meet the need of an inexpensive satisfactory electric oven for university and college laboratories requiring a number of ovens to replace the unsatisfactory gas-heated copper ovens, the use of which is rapidly passing.

SPECIFICATIONS.

Size of Chamber: 10x12 in.
Range:—Few degrees above air to 150° C.

Construction:—Of heavy asbestos wood with cast aluminum frame and door; cast aluminum racks allowing the perforated aluminum shelves to be placed at any desired height. Easily removable and correctly wound heating plate. Metallic regulator holding temperature to within a degree. Electric lamp to indicate when current is *made* and *broken.*

The only low-priced students' oven that has no parts unsuited to severe laboratory usage. Constructed for long service.

EIMER & AMEND

FOUNDED 1851

Headquarters for Educational and Industrial Laboratory Supplies

NEW YORK CITY
205-211 Third Ave.

PITTSBURGH, PA.
3006 Jenkins-Arcade Bldg.

certainly a better preparation for a successful book, than the usual method of writing secondary school textbooks where some professor feels the inspiration or more likely receives an offer from a publishing house and with the aid perhaps of stenographer and student assistants writes a book for us such as he thinks we ought to have.

Both Dr. Caldwell and Mr. Eikenberry have been students of education for some years. Dr. Caldwell has spent much time observing the teaching of general science in other schools. We enlarge upon the points mentioned above because such preparation for the writing of textbooks is very unusual. Teachers of science especially have been inflicted with cloister-made books until we wonder if there is ever to be any relief. It is certainly refreshing to receive a book that is the result of an actual try-out with live pupils. May the time hasten when we shall have more books written in this fashion.

It is difficult to adequately review this book in the space allowed here. We shall try to give some notion of the method of attack and the content, hoping that what we say may lead to an examination of the book itself by those interested. The book is divided into five parts under the following topics,—the air, water and its uses, work and energy, the earth's crust, life upon the earth. Each of these is developed under several heads. The topic "air," for example, has the following subheads,—characteristics of the air, temperature changes, water of the air, weather, structure and the molecular theory, composition and the atomic theory, relation of air to food manufacture (photosynthesis of plants), dusts, molds and bacteria of the air, distribution of bacteria and other disease germs. It will be seen that there is unity in these topics which the pupil can easily appreciate, and the life problems easily grow out of the discussion.

Under "water and its uses" we again reach life problems in the discussion of the relation of bodies of water to climate and commerce and finally to sewage disposal. We cannot go through all the topics in this manner but there is one important feature that is worthy of special note. The last topic "life upon the earth" can easily lead in a very satisfactory way to the required physiology and indeed if the sections on dust and bacteria are adequately taught can take the place of much of the perfunctory work usually called physiology. There would seem to be here a chance for a substantial saving of time which is too often practically wasted.

The book is planned for an entire year's work. Nearly a year can be obtained in schools where physiology is required by combining physiology and general science as suggested above. Suggestions are made by the authors for shorter courses, but this of course would mar the unity of the work. We believe the authors have made a real contribution to the art of textbook making in general and to general science textbooks in particular. W. W.

The Rural School and Hookworm Disease, by Jno. A. Ferrell, M. D. Assistant Director General International Health Commission, Washington, D. C. Bulletin No. 20, U. S. Bureau of Education. Paper. Pages 43. Illustrated. 1914. Published by the Government Printing Office.

For one interested in the study of the Hookworm disease and the methods being used in the rural schools of the South in combating its spread this pamphlet will be of much service. It first discusses the disease itself and then in a very detailed manner describes the various means used in the schools, as centers of instruction for the neighborhood, to cure children already infected and give instruction in sanitary living as a preventive. The bulletin may be obtained of the Superintendent of Documents, Government Printing Office. Price 15c. W. W.